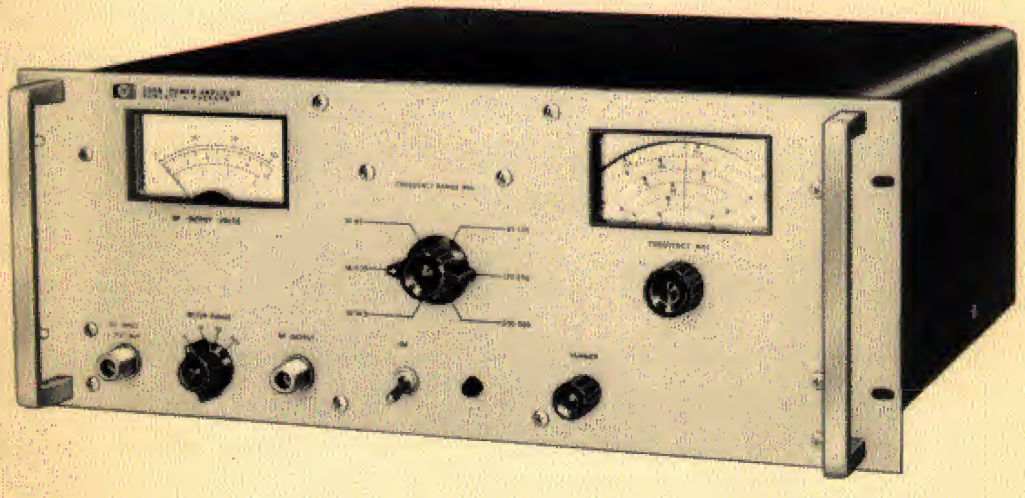
FOR SERIAL No. 1202A03721

OPERATING AND SERVICE MANUAL

# POWER AMPLIFIER

## 230B



HEWLETT hp PACKARD

HP230B

# POWER AMPLIFIER

# MODEL 230B

OPERATING AND SERVICE MANUAL

FOR SERIALS 935-02700 - up*

*For Serials Above 935-02700
A change page may
be included.

Green Pond Road, Rockaway, New Jersey 07866

HP Part No. 00230-~~90001~~
90039

Printed: August, 1969

# TABLE OF CONTENTS

## LIST OF ILLUSTRATIONS



## LIST OF TABLES

# SECTION I
# GENERAL INFORMATION

## 1-1 DESCRIPTION

1-2 The Model 230B Signal Generator Power Amplifier, shown on the cover, is manufactured by Hewlett-Packard. The amplifier offers a convenient way of obtaining high level RF from the output of conventional signal generators. When used in 50 ohm systems, it is capable of producing up to 4.5 Watts output in the 10MHz to 500MHz frequency range and will reproduce AM, FM, Pulse or CW modulation within its bandwidth capabilities. The 230B employs three grounded grid amplifiers to produce linear, class AB, operation with a typical noise figure of 6 to 9dB. The entire 10 to 500MHz is covered in six ranges and an RF voltmeter is provided which indicates the voltage at the front panel RF OUTPUT connector. Complete specifications are provided in Table 1-1.

## 1-3 INSTRUMENT IDENTIFICATION

1-4 Each Model 230B carries a two-section, eight-digit serial number (e. g. , 000-00000) which is stamped on a plate fastened to the rear panel. The five-digit number is an identification unique to each instrument, and the three-digit number is a serial prefix used to document instrument revisions.

1-5 When the SERIALS PREFIXED number on the title page of this manual is the same as the first three digits of the instrument serial number, the manual applies directly to the instrument. A change sheet will be included with the manual for newer instruments having a higher serial prefix than shown on the title page. If a change sheet is missing, it can be supplied by any Hewlett-Packard Sales Office listed at the back of this manual.

Table 1-1. Specifications

FREQUENCY RANGE:
- Range 1: 10 to 18.5MHz
- Range 2: 18.5 to 35MHz
- Range 3: 35 to 65MHz
- Range 4: 65 to 125MHz
- Range 5: 125 to 250MHz
- Range 6: 250 to 500MHz

RF GAIN
- 30dB (10 to 125MHz)
- 27dB (125 to 250MHz)
- 24dB (250 to 500MHz)
- (with 10 Volts output into 50 ohms)

RF BANDWIDTH
- >700kHz (10 to 150MHz)
- >1.4MHz (150 to 500MHz)
- (with 10 Volts output into 50 ohms)

RF OUTPUT
- Level: Up to 15 Volts across external 50 ohm load (4.5 Watts).

LEVEL MONITOR
- Ranges: 3, 10, 30 Volts full-scale
- Accuracy: 10% from 10 to 500MHz

FREQUENCY CALIBRATION:
- Calibration: Increments of approximately 10% accurate to ±10%.

AM CHARACTERISTICS
- AM Range: Reproduces 0 to 100% modulation of driving source.
- AM Distortion: <10% added to distortion of driving source, up to 5 Volts maximum carrier output for up to 100% AM.

FM CHARACTERISTICS
- FM Range: Reproduces modulation of driving source, except as limited by RF bandwidth.
- Incidental AM: <10% added to modulation of driving signal generator at 150kHz deviation.
- FM Distortion: Negligible distortion added to distortion of driving signal generator for <150kHz deviations and modulation frequencies.

POWER REQUIREMENTS
- 105 to 125 Volts or 210 to 250 Volts, 50 or 60Hz, 150 Watts.

CONNECTORS: Type N Female.

# SECTION II
# INSTALLATION

## 2-1 INITIAL INSPECTION

2-2 MECHANICAL CHECK

2-3 If damage to the shipping carton is evident, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for scratches, dents, broken knobs and switches, and any other mechanical damage. Also check the cushioning material for signs of severe stress as an indication of rough handling in transit.

2-4 PERFORMANCE CHECK

2-5 The electrical performance of the 230B should be verified as soon as possible after receipt. A performance check that is suitable for initial inspection is contained in Section V.

2-6 CLAIM FOR DAMAGE

2-7 If upon receipt, the 230B is damaged or fails to meet performance specifications, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately (a list of offices is provided at the back of this manual). Retain the shipping carton and padding material for the carrier's inspection.

## 2-8 PREPARATION FOR USE

2-9 POWER REQUIREMENTS

2-10 The 230B requires a power source of 105 to 125V or 210 to 250V, 50 or 60Hz, 150 Watts.

2-11 115/230 VOLT OPERATION

2-12 A two position slide switch, located on the rear panel, permits operation from either a 115 or 230 Volt source. Before connecting the 230B to the power source, check that the number visible on the slide switch matches the line voltage. If required, slide the switch to the other position using a thin-bladed screwdriver.

2-13 When the instrument leaves the factory, the proper fuse is installed for 115 Volt operation. An envelope containing a fuse for 230 Volt operation is attached to the front handle. Be sure that the correct fuse is installed if the position of the slide switch is changed. Markings on the chassis next to the slide switch indicate the correct fuse rating for operation from either source.

2-14 POWER CABLE

2-15 To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that instrument panels and cabinets be grounded. The 230B is equipped with a detachable, three-conductor power cable which, when plugged into an appropriate receptacle, grounds the panel and cabinet of the instrument. The offset pin on the power cable three-prong connector is the ground pin. The power connector is in accordance with CEE 22, Standard VI.

2-16 To preserve the protective feature when operating the instrument from a two-contact outlet, use a three-prong adapter (℗ Stock No. 1251-0048) and connect the green pigtail on the adapter to ground.

2-17 COOLING

2-18 The 230B uses a forced-air cooling system. The air intake and filter are located at the rear of the instrument. For adequate ventillation, allow at least 3 inches clearance around the filter and cabinet ventillation holes.

**CAUTION**

Damage to 230B components may result from a dirty air filter. Check filter regularly and clean when necessary.

2-19 RACK MOUNTING

2-20 The 230B is designed for either bench or rack mounting operation. To install it in a rack

type installation, remove the four rubber feet from the bottom plate.

2-21 REPACKAGING FOR SHIPMENT

2-22 The original shipping carton and packing material should be used for repackaging. A Hewlett-Packard Sales and Service Office will provide information and recommendations on materials to be used if the original packaging materials are not available or reusable.

**NOTE**

If the instrument is to be shipped to a Hewlett-Packard Sales and Service Office, attach a tag showing owner, model number, complete serial number, and repairs required. Mark the shipping container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

# SECTION III
# OPERATION

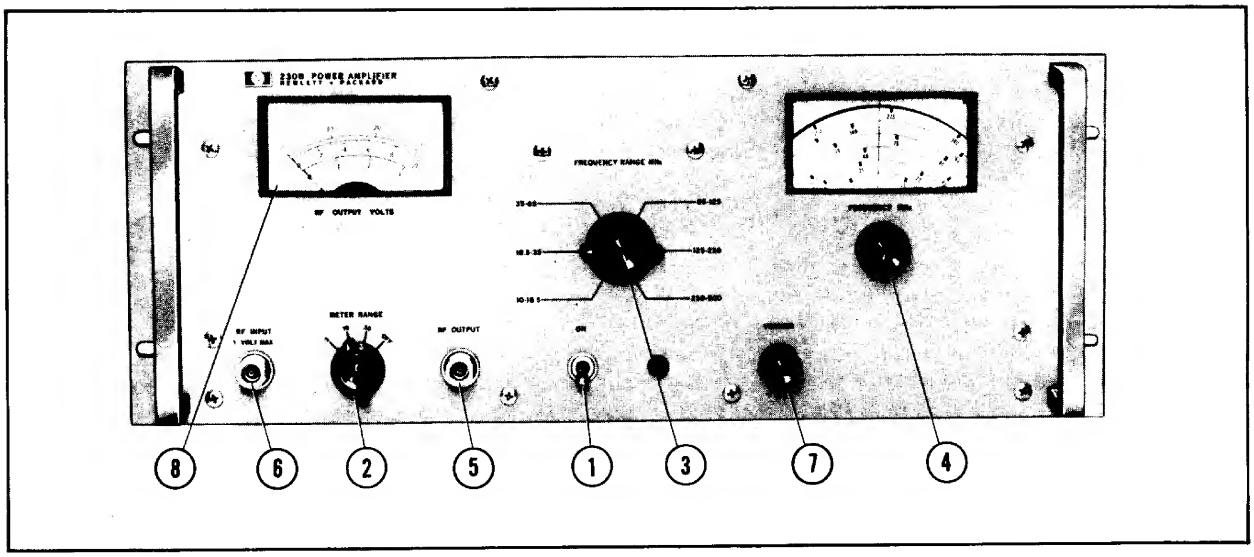



Figure 3-1. 230B Operating Controls

## 3-1 INTRODUCTION

3-2 The 230B Power Amplifier is designed to increase the output power of a conventional signal generator and becomes a high level signal source in the VHF range from 10MHz to 500MHz. With a typical noise figure of 6 to 9dB, the instrument provides up to 30dB of gain and a maximum power output of 4.5 Watts. It can be driven with any conventional signal source, and will reproduce AM, FM, and Pulse modulation within the 230B bandwidth limitations. The 230B may be used for both high and low level applications.

## 3-3 CONTROLS AND INDICATORS

3-4 Figure 3-1 identifies the function of the front and rear panel controls, indicators, and connectors.

## 3-5 OPERATING INSTRUCTIONS

3-6 The following paragraphs describe the 230B turn-on and operating procedures. All numbers following control and connector names refer to callouts in Figure 3-1.

3-7 TURN-ON PROCEDURE

3-8 To turn on the 230B, proceed as follows:

a. Check that 115/230 Volt slide switch is set for the nominal line voltage. The switch position can be changed by using a thin-bladed screwdriver.

b. Check that proper line fuse is installed in the fuseholder. The correct fuse rating is marked on the chassis next to the 115/230 Volt slide switch.

c. Connect one end of power cable to the line input connector and the other end to the appropriate line voltage source.

d. Set power switch (1) to ON position, and allow 15 minutes warm-up before proceeding.

3-9 OPERATING PROCEDURES

3-10 To operate the 230B as a power amplifier, proceed as follows:

**CAUTION**

To avoid output circuit damage, especially at the high end of the first two ranges (18.5MHz and 35MHz), DO NOT operate unit with more than one Volt input or an unterminated output.

a. Set voltmeter RANGE switch (2) to 30.

b. Set Frequency Range switch (3) to desired range.

c. Adjust FREQUENCY MHz (4) to desired range.

d. Connect RF OUTPUT connector (5) to equipment under test.

e. Connect external signal to RF INPUT connector (6).

f. Using the VERNIER tuning control (7), tune for a maximum indication on the voltmeter (8). The output voltage is then read directly from the meter.

3-11 FREQUENCY RESPONSE

3-12 Figure 3-2 illustrates 230B typical bandwidth at the response curve 3dB points. The 230B reproduction fidelity for AM signals is dependant upon two factors; (1) the 230B bandwidth at the frequency to which it is tuned and (2) the modulating frequency of the input signal. The minimum 230B bandwidth at the response curve 3dB points is approximately 700kHz.

3-13 The reproduction fidelity of FM signals can be determined by the following relationship:

$$BW \text{ required} = 2 \text{ (MOD FREQ) } (M + 1)$$

$$\text{When } M = \frac{\text{Deviation}}{\text{Modulating Freq}}$$

Where: BW = Bandwidth
M = Modulation Index

Using Figure 3-2, the required bandwidth may be compared with the 230B typical bandwidth at the frequency desired.

3-14 If the 230B does not have sufficient bandwidth at the desired frequency, the first and second RF amplifiers may be stagger tuned to provide more bandwidth. However, by obtaining bandwidth in this manner, there will be a sacrifice of gain.

3-15 RF VOLTMETER

3-16 The meter detector is physically connected to the output connector. When operating at the higher frequencies, the length of the connecting lead becomes important in that if there is a mismatch between the 230B output impedance and the load impedance, there could be sufficient VSWR to cause the meter to read something other than the actual voltage at the RF OUTPUT connector.

3-17 VSWR

3-18 The Model 230B was designed for use in 50 ohm systems. A wide-band, tuned amplifier, such as the 230B, however, cannot maintain a constant output impedance without a complex method of controlling both output coupling coefficient and tank circuit reactance, or allowing for an insertion loss of a broad-band matching pad. Where the application requires it, the 230B input and output impedances may be matched to the source or load through matching networks, pads, or stub tuners, depending upon power gain requirements and operating frequency.

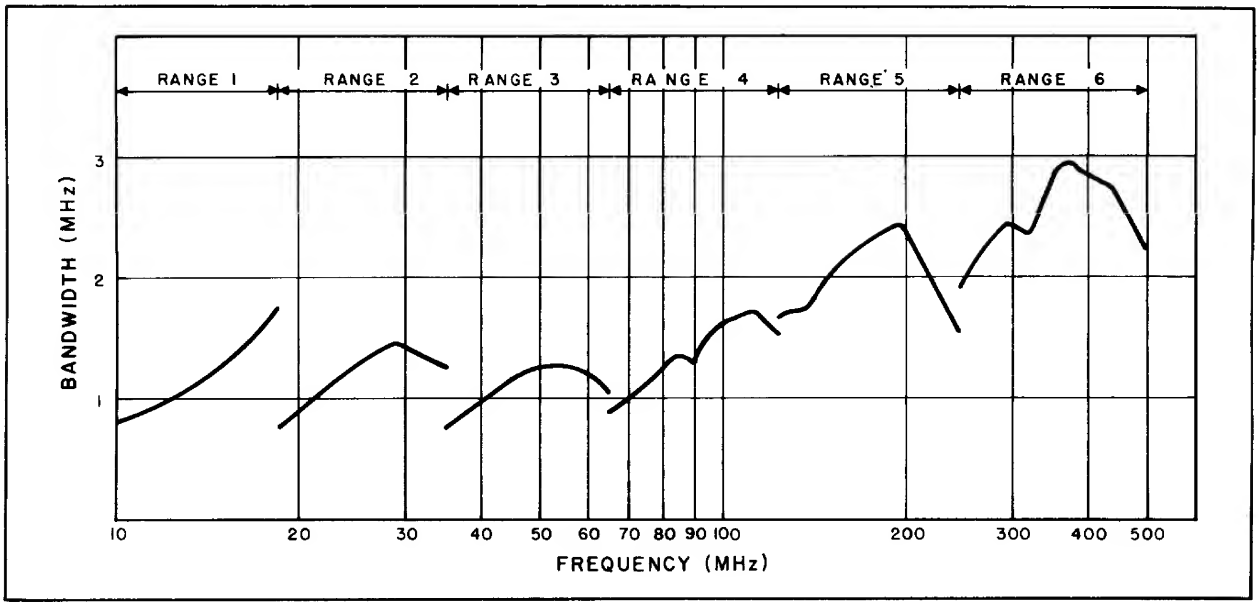



Figure 3-2. 230B Bandwidth vs Frequency

3-19 NOISE FIGURE

3-20 The equivalent noise figure for the 230B is kept very low; typically 6 to 9dB over the entire frequency range.

## 3-21 APPLICATIONS

3-22 The following paragraphs list some typical 230B applications.

3-23 AGC CHARACTERISTICS

3-24 AGC (automatic gain control) characteristics are measured or determined by measuring the relationship between RF input voltage and the dc voltage bias developed by the AGC detector. it is often desirable to determine the RF level which will override the AGC and cause blocking and/or distortion. This level is often much higher than 500,000 microvolts in well-designed systems.

3-25 SKIRT SELECTIVITY

3-26 Skirt selectivity testing of a communications system requires that the performance of the frequency selective circuits be determined at a frequency considerably removed from the desired frequency, or on the "skirts" of the resonance curve, where attenuation is at a very high value. Typical values are 2 to 5 Volts for attenuation figures of 80 to 120dB. In this test, one must be cautious of the possibility of overload occurring before the desired point on the skirt is reached. In AM systems, an increase in distortion indicates that overloading has taken place and limits the extent of the "skirt" measurement.

3-27 ADJACENT CHANNEL DESENSITIZATION TEST

3-28 Most communication centers transmit on many channels simultaneously. Usually, a given receiver will be in contact with signals of less than 100 microvolts in strength, while one or more transmitters in the same room are operating at a frequency only a few channels from the receiver frequency. The receiver must not, therefore, be affected by strong signals in adjacent channels. It is for this reason that desensitization characteristics are specified by communication system designers, and the desensitization tests are made.

3-29 Desensitization tests are made by connecting the equipment as shown in Figure 3-3. Signal generator #1 is set to give a convenient metered detector level (sometimes specified for a given system). This is the "desired signal" on channel. Using signal generator #2 in conjunction with the 230B Power Amplifier, the adjacent channel level is raised until the detector level is reduced by a specific amount (usually 3dB). The reading on the 230B voltmeter is twice the voltage required for "desensitization".

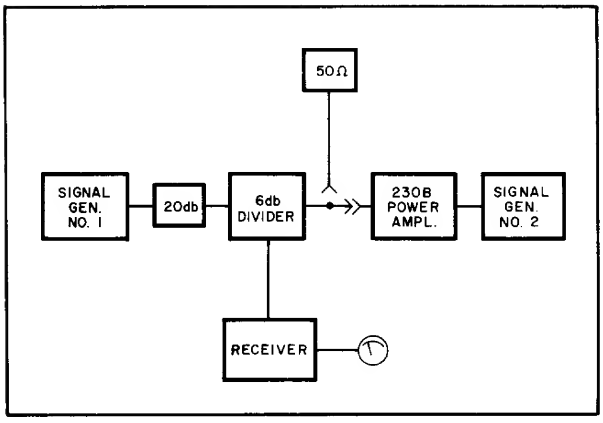



Figure 3-3. Connections For Desensitization

3-30 HIGH LEVEL DRIVER

3-31 As a high level driver, the 230B can be used to power bridges and slotted lines to improve the resolution and accuracy of these measurements. Computers that require high-level signal sources for synchronizing purposes, at moderately high frequencies, may also be driven by the 230B Power Amplifier.

3-32 ANTENNA TESTING

3-33 The 230B is capable of supplying moderate power for antenna measurements, while, at the same time, providing relatively small leakage from the Power Amplifier itself.

3-34 ATTENUATION MEASUREMENTS

3-35 Using the 230B Power Amplifier and an RF millivolt meter, attenuation measurements can be made in the order of 80dB. The 230B provides an additional 24 to 30dB of gain or signal level (assuming the circuit being measured will permit the high voltage) to add to the existing measuring system in the field of attenuation measurements, filters, long transmission lines, etc., can be tested in this manner.

3-36 Certain of these applications are susceptible to the absolute values of the source or load impedance. Where these impedances are critical, matching pads, attenuators, stub tuners or tunable networks may be employed to accomplish the necessary proper match for the application.

3-37 FREQUENCY MULTIPLYING

3-38 A number of approaches to this application

are possible. First, it is possible to amplify the harmonics present in the input signal. The output under these conditions is in the order of 0.2 to 0.5 Volts, with 0.2 Volts of fundamental input. Another approach is to use a semiconductor harmonic generator to augment the harmonics present in the input signal. This technique yields several Volts output, depending upon the input levels available. If sufficient input is available, the 230B input stage may be overdriven and the attendant distortion will produce higher harmonic levels. Approximately 1 to 2 Volts may be expected for inputs of the order of 1 Volt. A crystal frequency synthesizer output may be multiplied as many as ten times, extending the usefulness of these units to the UHF range. Further information is contained in the Hewlett-Packard Application Note 920, "Harmonic Generation using Step Recovery Diodes and Step Recovery Diode Modules" available through your local HP office.

# SECTION IV
# THEORY OF OPERATION

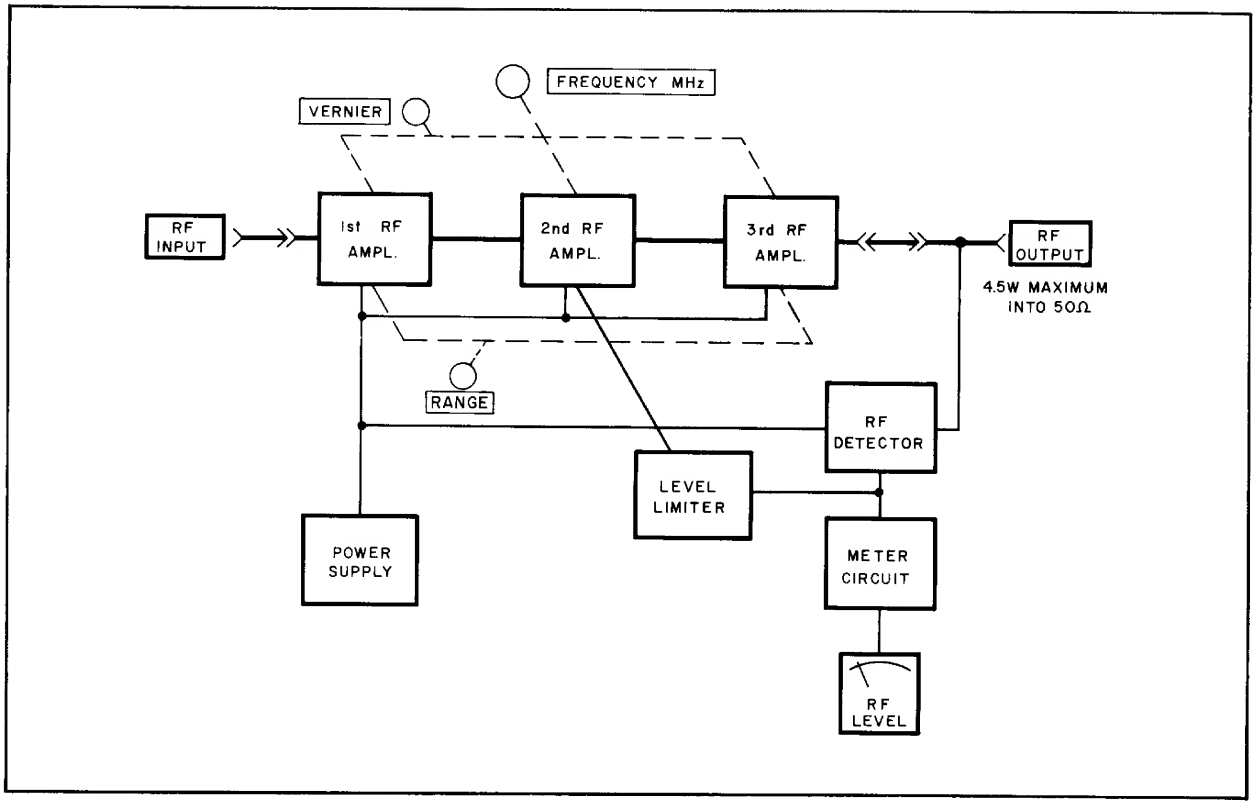



Figure 4-1. 230B Block Diagram

## 4-1 INTRODUCTION

4-2 The Model 230B Power Amplifier is capable of increasing low level signals up to 30dB. It employs three grounded-grid amplifiers, tuneable from 10MHz to 500MHz, in three ranges, and an RF voltmeter to monitor the output.

## 4-3 OVERALL DESCRIPTION

4-4 Figure 4-1 is a block diagram of the 230B. The input signal is amplified by the three grounded-grid amplifiers, the first being operated class A and the second and output amplifiers operated class AB.

4-5 At the output, a portion of the RF output is detected and used to drive the RF voltmeter. The voltmeter is calibrated to read rms Volts.

## 4-6 DETAILED DESCRIPTION

4-7 RF AMPLIFIERS

4-8 The RF amplifiers in the 230B use conventional grounded-grid circuitry. Special 2C39A tubes with reduced size radiators are used in all three stages to increase coupling efficiency at 500MHz. Since all three stages are alike only the second stage will be discussed.

4-9 Transistors Q1 and Q2 and associated components form an output level limiter. During normal operation, VR6 is non-conducting. Q1-Q2 are held in saturation by the positive current source through R11. The cathode current of V2 flows through CR7 and Q2 (normally saturated) and provides a fixed bias of approximately +1.4V at the cathode of A2V2.

4-10 When the RF output voltage exceeds approximately 30Vrms (43V pk) VR6 begins to conduct. This reduces the current flow into the base of Q1 thus causing Q2 to go out of saturation. Since the cathode current of V2 is flowing through Q2, its Vce increases. This in turn increases the + voltage at the cathode of V2 which reduces the output to a point not exceeding 30Vrms. This action reduces the possibility of any internal damage that might occur if the output exceeded 30Vrms.

4-11 The tuned plate circuit consists of C11 and C12 in series across the plate circuit inductance. As the 230B is tuned from the low end of a range to the high end, a point is reached (approx. 320 MHz on range 6) at which C12 becomes ineffective as part of the tuning process. At this point the circuit changes from series-parallel tuned to series tuned. This is accomplished by making the piston of C12 (C4 and C18) physically shorter than C11 (C4 and C18). The results of this tuning method are greater tuning ratio, and less compression of frequencies at the high end of the dial. The complete frequency range is covered by inserting different value plate circuit inductors, by means of a turrent switching assembly.

4-12 The plate circuit inductors for the first and output stages are identical while those of the second stage are wound in the reverse direction from the other two stages. This reduces the possibility of regeneration occuring.

4-13 METER CIRCUIT

4-14 The meter circuit provides an indication of the rms output. The RF detector provides the input to the circuit. The METER RANGE switch selects the desired range by providing the proper voltage dividing resistor in series with the meter. R13 allows calibration of the meter sensitivity.

4-15 POWER SUPPLY

4-16 The 230B power supply consists of power transformer T1, bridge rectifier CR1-CR4, series regulator V1, error amplifier V2 and reference tube V3.

4-17 The cathode of V1 supplies a regulated + 320 Volts to the three RF amplifiers. Series regulator V1 serves as an adjustable impedence in series with the output, controlled by error amplifier V2. Error amplifier V2 samples a portion of the regulated output obtained from a voltage divider consisting of R4, R5 and R18. R18 is adjusted for + 320 Volts at the cathode of V1.

4-18 Regulation is accomplished by the application of the sampled voltage to the grid of V2. V2 amplifies any changes in the output and applies it in the proper phase and amplitude to the grid of V2. This causes V2 to conduct more or less in accordance with the error signal applied to it, thus obtaining the proper well-regulated output at the cathode of V1.

4-19 V3 supplies a constant voltage to the cathode of V2 and to the meter circuit which is used as a reference voltage.

# SECTION V
# MAINTENANCE

## 5-1 INTRODUCTION

5-2 This section contains information required to maintain the 230B Signal Generator Power Amplifier. The information covered is summarized below:

a. TEST EQUIPMENT REQUIRED - Lists and describes test equipment necessary to perform the operations in this section.

b. PERFORMANCE CHECKS - Verify proper operation of the 230B.

c. ADJUSTMENT PROCEDURES - Used to adjust the 230B after repair.

d. COMPONENT REPLACEMENT PROCEDURES - Describes step by step procedures for major component replacement.

e. TROUBLESHOOTING PROCEDURES - Aid in locating malfunctions.

## 5-3 TEST EQUIPMENT REQUIRED

5-4 Instruments required to perform the operations in this section are listed in Table 5-1. This table lists the type of instrument required, critical specifications, and recommended model or type. For operating instructions refer to the manual supplied with the equipment. If the equipment listed is not available, equipment which meets or exceeds the critical specifications may be used.

Table 5-1. Test Equipment Required

| INSTRUMENT OR ACCESSARY TYPE | CRITICAL SPECIFICATIONS | RECOMMENDED INSTRUMENT OR ACCESSARY |
|---|---|---|
| Oscilloscope | Bandwidth: dc to 500kHz<br>VERT sensitivity: 0.1V/cm<br>HORIZ sensitivity: 1.0V/cm | HP 130C |
| Sweep Generator | Frequency range: 10-500MHz<br>Markers: 1, 10, 50MHz<br>Output: 1.0V rms into 50 Ohms | Texscan VS50 |
| Power Meter | Range: -20 to +10 dBm<br>Accuracy: ±1% on +5 dBm Range | HP 431C |
| Xtal Detector | Frequency response flat from 10 to 500MHz | HP 423A |
| 10 dB Attenuator | Frequency Range: dc to 12.4GHz<br>Accuracy: ±0.5 dB<br>Maximum input power: 2W average | HP 8491A<br>Opt 10 |
| 20 dB Attenuator | Frequency range: dc to 12.4GHz<br>Accuracy: ±0.5 db<br>Maximum input power: 2W average | HP 8491A<br>Opt 20 |
| RF Voltmeter | Range: 1mV to 3V fullscale<br>Frequency range: 10kHz to 1.2GHz | HP 3406A |
| DC Voltmeter | Range: 1mV to 1000V full scale<br>Accuracy: ±1% | HP 412A |

Table 5-1. Test Equipment Required (Continued)

| INSTRUMENT OR ACCESSARY TYPE | CRITICAL SPECIFICATIONS | RECOMMENDED INSTRUMENT OR ACCESSARY |
|---|---|---|
| AC Voltmeter | Range: 1mV to 1000V full scale<br>Frequency range: 40Hz to 1MHz<br>Accuracy: ±1% | HP 400E |
| Variable Transformer | Output: 115V ± 20% or 230V ± 20%<br>Current: 2A | General Radio Type W10M3TA |
| Tuning Tool | 6 in. length of 1/8 Nylon rod with blade tip | |
| Electronic Counter | 10 - 500MHz | HP 5245L with 5253B Plug-in |

## 5-5 PERFORMANCE CHECKS

5-6 The Performance Checks verify 230B operation within its rated specifications (see Section I, Table 1-1). They may be used:

a. As part of incoming inspection
b. As monthly routine reliability checks
c. Before returning to normal service after being repaired
d. For troubleshooting purposes

5-7 A sample Performance Check Test Card is included in this section. The card may be duplicated and completed during 230B Performance Checks to provide a permanent record.

5-8 FREQUENCY DIAL ACCURACY

5-9 To check the frequency dial accuracy, proceed as follows:

a. Connect equipment as shown in Figure 5-1.

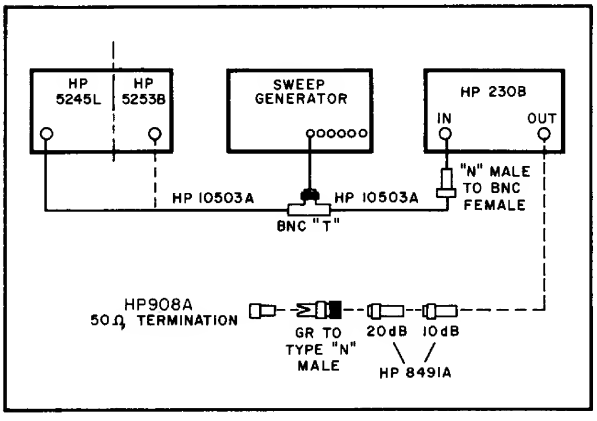



Figure 5-1. 230B Frequency Accuracy Test Setup

b. Set sweep generator controls as follows:
CENTER FREQUENCY See chart below
SWEEP WIDTH CW
ATTENUATION to maintain 5-10V output as read on 230B voltmeter.

c. Adjust 230B and sweep generator to frequencies listed in chart. The electronic counter should read between the limits shown.

| 230B DIAL FREQUENCY | COUNTER LIMITS |
|---|---|
| 10MHz | 9 - 11MHz |
| 14MHz | 12.6 - 15.4MHz |
| 18MHz | 16.2 - 19.8MHz |
| 19MHz | 17.1 - 20.9MHz |
| 27MHz | 24.3 - 29.7MHz |
| 35MHz | 31.5 - 38.5MHz |
| 50MHz | 45 - 55MHz |
| 65MHz | 58.5 - 71.5MHz |
| 95MHz | 85.5 - 104.5MHz |
| 125MHz | 112.5 - 137.5MHz |
| 180MHz | 162 - 198MHz |
| 250MHz | 225 - 275MHz |
| 375MHz | 337.5 - 412.5MHz |
| 500MHz | 450 - 550MHz |

5-10 BANDWIDTH CHECK

5-11 To check the bandwidth, proceed as follows:

a. Connect equipment as shown in Figure 5-2.

**CAUTION**

Always disconnect the input to the 230B before disconnecting the output. Operating the instrument without a load may cause serious electrical damage.

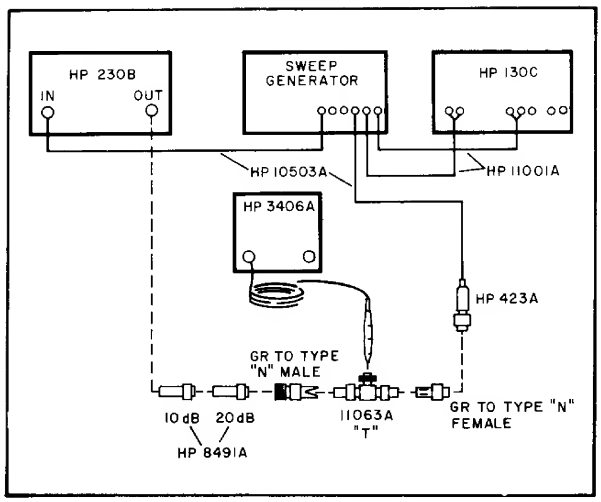



Figure 5-2. 230B Bandwidth Test Setup

b. Set sweep generator controls as follows:

| | |
|---|---|
| CENTER FREQUENCY | 10MHz (approx.) |
| ATTENUATION | 30dB |
| SWEEP WIDTH | CW |
| SWEEP RATE | 5-50Hz |
| SWEEP RATE vernier | FULL CW |
| Markers on | none |

c. Set oscilloscope controls as follows:

| | |
|---|---|
| VERTICAL INPUT | DC coupled |
| VERTICAL SENSITIVITY | 0.1V/cm |
| VERNIER | CAL |
| HORIZONTAL INPUT | DC coupled |
| HORIZONTAL SENSITIVITY | 1.0V/cm |
| VERNIER | CAL |

d. Set external RF voltmeter controls as follows:

| | |
|---|---|
| RANGE | 0.3 Volt |

e. Set 230B controls as follows:

| | |
|---|---|
| Range | 10 - 18.5 |
| FREQUENCY MHz | 10 |
| Voltmeter RANGE | 30 |

f. Adjust 230B VERNIER for maximum output and sweep generator ATTENUATOR and RF vernier for 0.316 Volts on external RF voltmeter.

g. Change sweep generator controls as follows:

| | |
|---|---|
| SWEEP WIDTH | NARROW |
| Markers on | 1MHz |

h. Adjust sweep generator SWEEP WIDTH vernier until 1MHz equals 2cm on the oscilloscope graticule.

i. Using the oscilloscope VERTICAL POSITION control adjust for trace shown in Figure 5-3A.

j. Decrease sweep generator ATTENUATION 3dB.

k. The bandwidth between the two points where the waveform crosses the horizontal axis (see Figure 5-3B) should be 700kHz or 1.4cm minimum.

l. Using the above procedure, check several frequencies on each of the first three ranges. The 3dB bandwidth should be 700kHz minimum at any frequency.

m. On ranges 4, 5, and 6, repeat steps (a) through (l) using a SWEEP WIDTH setting of WIDE and adjusting 1MHz to equal 1cm in steps (g) and (h) respectively.

n. The 3dB bandwidth should be 700kHz minimum to 150MHz and 1.4MHz minimum from 150 to 500MHz.

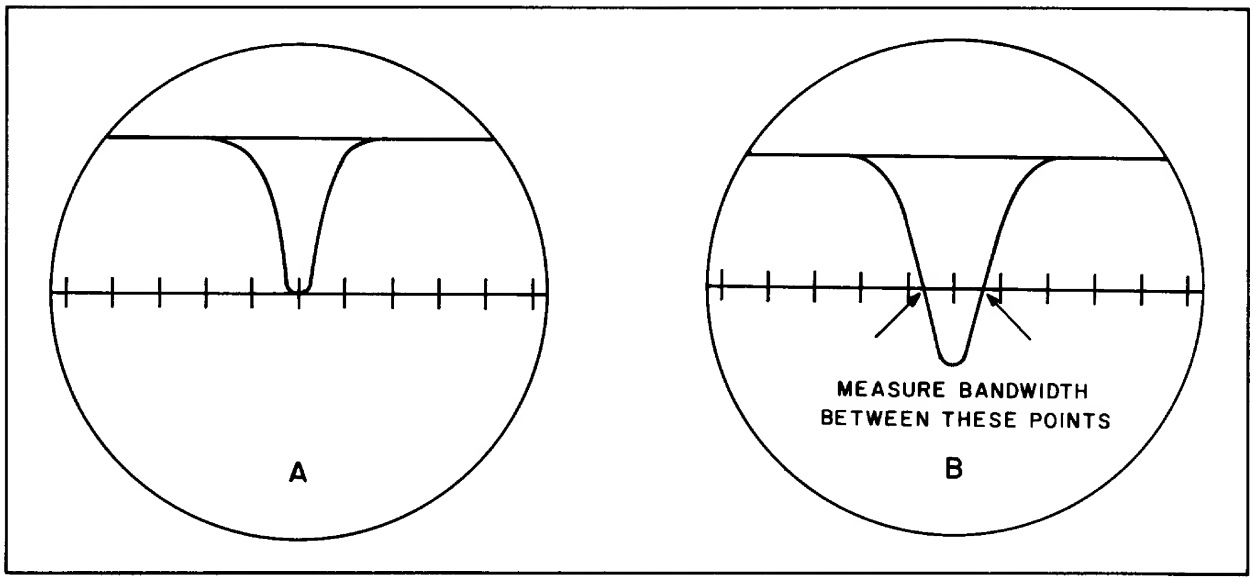



Figure 5-3. 230B Bandwidth Check Waveforms

o. Adjust sweep generator and 230B frequency controls from the low end to the high end of each range while noting the frequency on each range at which minimum output occurs.

**NOTE**

Adjust sweep generator ATTENUATION and SWEEP WIDTH controls as necessary for an on-screen oscilloscope display.

5-12 GAIN CHECK

5-13 To check the gain, proceed as follows:

a. Connect equipment as shown in Figure 5-4.

b. Set 230B controls as follows:

| | |
|---|---|
| Range | 10 - 18.5MHz |
| FREQUENCY MHz | Frequency of lowest output. |

c. Set sweep generator controls as follows:

| | |
|---|---|
| CENTER FREQUENCY | Same as 230B |
| SWEEP WIDTH | CW. |

d. Set power meter controls as follows:

| | |
|---|---|
| RANGE | +5dBm |

e. Adjust sweep generator ATTENUATION and CENTER FREQUENCY controls for maximum output from the 230B as read on the power meter +5dBm range.

f. Adjust sweep generator RF VERNIER for a -2 reading on the power meter dBm scale, corresponding to +33dBm or 10V into 50 ohms.

g. Disconnect input to 230B and power meter.

h. Connect sweep generator RF OUT to power meter and note reading.

i. The 230B gain is equal to the algebraic difference between the 230B output and the sweep generator output and can be found by the following method:

GAIN = +33 - (sweep generator output from step h)

EXAMPLE: +33 - (-3) = +36dB

+33 - (+5) = +28dB.

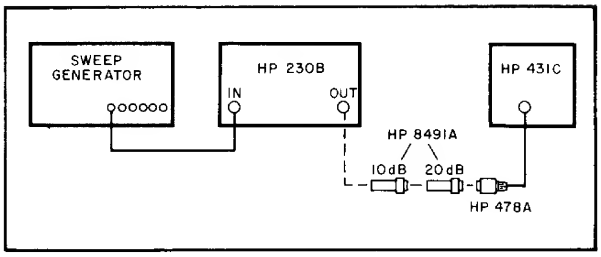



Figure 5-4. 230B Gain Check Setup

j. The 230B gain should be 30dB minimum.

k. Reconnect power meter and sweep generator to 230B.

l. Adjust auto transformer to 105Vac.

m. Repeat steps (e) through (i). The 230B gain should be 30dB minimum.

n. Repeat steps (a) through (m) for each frequency noted in Paragraph 5-11, step (o). The gain should be 30dB minimum from 10 to 125MHz, 27dB minimum from 125 to 250MHz, and 24dB minimum from 250 to 500MHz.

5-14 VOLTMETER ACCURACY

5-15 To check the voltmeter accuracy, proceed as follows:

a. Connect test equipment as shown in Figure 5-5.

b. Set 230B controls as follows:

| | |
|---|---|
| Range | 10 - 18.5MHz |
| FREQUENCY MHz | 10 |
| Voltmeter RANGE | 3 |

c. Set sweep generator controls as follows:

| 230B VM RANGE | RF OUTPUT AS READ ON EXTERNAL RF VOLTMETER | 230B METER LIMITS |
|---|---|---|
| 3 | 0.1 | 0.9 - 1.1 |
| 3 | 0.2 | 1.8 - 2.2 |
| 3 | 0.3 | 2.7 - 3.3 |
| 10 | 0.3 | 2.7 - 3.3 |
| 10 | 0.4 | 3.6 - 4.4 |
| 10 | 0.5 | 4.5 - 5.5 |
| 10 | 0.6 | 5.4 - 6.6 |
| 10 | 0.7 | 6.3 - 7.7 |
| 10 | 0.8 | 7.2 - 9.0 |
| 10 | 0.9 | 8.1 - 9.9 |
| 10 | 1.0 | 9.0 - 11.0 |
| 30 | 1.0 | 9.0 - 11.0 |
| 30 | 1.2 | 10.8 - 13.2 |
| 30 | 1.5 | 13.5 - 16.5 |

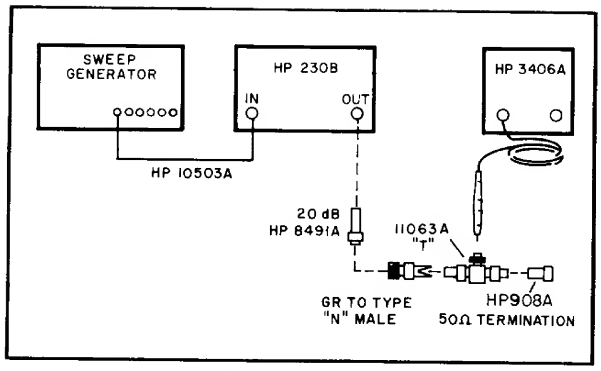



Figure 5-5. 230B Voltmeter Accuracy Setup

CENTER FREQUENCY 10MHz
SWEEP WIDTH CW

d. Adjust sweep generator ATTENUATION and RF VERNIER controls for 0.1 Volt on the external RF voltmeter. 230B voltmeter should read 0.89 to 1.10 Volts.

e. Adjust sweep generator for RF outputs listed below. The 230B voltmeter should indicate within limits listed.

f. Using the procedure in steps (d) and (e), any frequency may be checked against the limits listed in chart on previous page.

## 5-16 ADJUSTMENT PROCEDURES

5-17 The following adjustment procedures should be performed only if it has been determined by the Performance Checks in Paragraph 5-5 that the 230B is not within specifications. Tolerances associated with adjustments are given as aids to making the adjustments. These tolerances do not constitute a basis for qualification or acceptance of an instrument since no allowance has been made for temperature or aging effects. Qualification and overall performance should be based on the specifications listed in Section I, Table 1-1.

**NOTE**

Except where indicated, adjustments and tests are made at nominal line voltage.

5-18 PREPARATION FOR ADJUSTMENT

5-19 To obtain access to capacitor and coil slug adjustments it will be necessary to remove the top cover.

5-20 METER MECHANICAL ADJUSTMENT

5-21 This procedure adjusts the RF voltmeter mechanical zero. Proceed as follows:

a. Turn on instrument and allow it to come up to normal operating temperature (about 20 minutes).

b. Turn the instrument off. Wait one minute for power supply capacitors to discharge completely.

c. Insert sharp pointed object (pen point or awl) into the small indentation near top of round black plastic disc located directly below meter face.

d. Rotate plastic disc clockwise (cw) until meter reads zero, then rotate ccw slightly in order to free adjustment screw from meter suspension. If pointer moves, repeat Steps c and d.

5-22 POWER SUPPLIES

5-23 This procedure checks and adjusts power supply voltages for the proper level. Proceed as follows:

a. Turn on 230B and allow 5 minutes warm up.

b. Measure heater voltages of V1, V2, and V3 with ac voltmeter. Voltage should be 5.9V ac ± 0.1Vac.

c. Adjust R18, VOLT ADJ, for + 320Vdc at V3 plate.

d. Adjust line voltage from 105 to 125Vac. + 320V should not change more than ± 5.0Vdc.

5-24 RF ADJUSTMENTS

5-25 The procedure for adjusting the 230B tuned circuits is given in the following paragraphs. For locations of adjustments, see Figure 5-6. The 230B may be initially adjusted with the amplifier box covers off; however, final adjustments must be performed with both covers securely in place. All adjustments are tuned for maximum output and

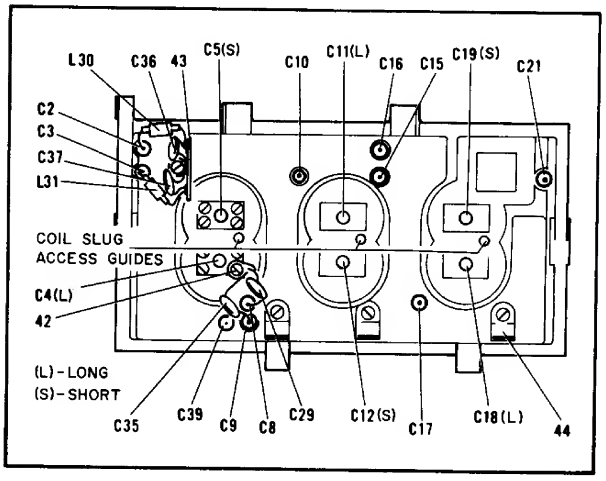



Figure 5-6. 230B Adjustments

proper frequency. Frequency accuracy is determined by the capacitor adjustments on range 6. The capacitors should not be moved during adjustment of the other five ranges.

5-26 After completing adjustment of a range and before proceeding to the next range, adjust the sweep generator and the 230B from one end of the range to the other while noting the frequency at which minimum output occurs. These points will be used during the gain check.

5-27 OSCILLOSCOPE CONTROL SETTINGS

5-28 Set oscilloscope controls as shown below. Once set, these controls will not be changed throughout the adjustment procedure. Should the waveform go off the screen, the sweep generator controls should be used to restore the waveform to normal.

5-29 250-500MHz ADJUSTMENT

5-30 The following procedure adjusts the 250-500 MHz range. Proceed as follows:

**NOTE**

The capacitor adjustments are performed on the 250-500MHz range only and should not be moved during subsequent range adjustments.

a. Connect equipment as shown in Figure 5-2.

b. Set sweep generator controls as follows:

| | |
|---|---|
| CENTER FREQUENCY | 500MHz |
| ATTENUATION | 16dB |
| ALC | INT |
| SWEEP WIDTH | WIDE |
| SWEEP RATE vernier | CW |
| SWEEP RATE | 5-50Hz |
| Markers on | 50MHz |

c. Set 230B controls as follows:

| | |
|---|---|
| Range | 250-500MHz |
| FREQUENCY MHz | 480MHz (approx) |
| Voltmeter RANGE | 30 |

d. Adjust sweep generator CENTER FREQUENCY until 500MHz marker is at the vertical center line of the oscilloscope graticule.

**NOTE**

If no waveform is visible, decrease sweep generator attenuation until waveform appears. As capacitors are adjusted, increase sweep generator attenuation to keep waveform on tne screen.

e. Adjust C4, C11, and C18 until 500MHz marker is at peak of waveform and waveform is at maximum amplitude. Tighten locknuts finger tight.

f. Change equipment control settings as follows:

| | |
|---|---|
| CENTER FREQUENCY | 400MHz |
| 230B FREQUENCY MHz | 390MHz |

g. Adjust sweep generator CENTER FREQUENCY until 400MHz marker is at the vertical center line of the oscilloscope graticule.

h. Using nylon tuning rod, adjust three coil slugs through holes in right side of amplifier box until 400MHz marker is at the waveform peak and the waveform is at maximum amplitude.

i. Change equipment controls as follows:

| | |
|---|---|
| CENTER FREQUENCY | 250MHz |
| 230B FREQUENCY MHz | 240MHz |

j. Adjust C5, C12, and C19 until 250MHz marker is at the waveform peak and the waveform is at maximum amplitude. Tighten locknuts finger tight.

k. Repeat Steps b through j.

l. Tighten locknuts being careful not to turn adjusting screws.

m. Adjust sweep generator and 230B from the low end to the high end of the range while noting frequency at which lowest output occurs.

n. Perform the Bandwidth and Gain checks given in Paragraph 5-5 for Range 6.

5-31 125-250MHz ADJUSTMENT

5-32 The following procedure adjusts the 125-250 MHz range. Proceed as follows:

a. Connect equipment as shown in Figure 5-2.

b. Set sweep generator controls as follows:

| | |
|---|---|
| CENTER FREQUENCY | 250MHz |
| ATTENUATION | 16dB |
| SWEEP WIDTH | WIDE |
| Markers on | 50MHz |

c. Set 230B controls as follows:

| | |
|---|---|
| Range | 125-250MHz |
| FREQUENCY MHz | 240MHz |

d. Adjust sweep generator CENTER FREQUENCY until 250MHz marker is at the vertical center line of the oscilloscope graticule.

e. Adjust three coil slugs until 250MHz marker is at the waveform peak and the waveform is at maximum amplitude.

f. Adjust sweep generator and 230B from the low end to the high end of the range while noting frequency at which lowest output occurs.

g. Perform Bandwidth and Gain checks given in Paragraph 5-5 for the range being adjusted.

5-33 65-125MHz ADJUSTMENT

5-34 The following procedure adjusts the 65-125

MHz range. Proceed as follows:

a. Connect equipment as shown in Figure 5-2.

b. Set sweep generator controls as follows:

| | |
|---|---|
| CENTER FREQUENCY | 125MHz |
| ATTENUATION | 23dB |
| Markers on | 1, 10, 50 |

c. Set 230B controls as follows:

| | |
|---|---|
| Range | 65-125MHz |
| FREQUENCY MHz | 125MHz |

d. Repeat Steps 5-24 d,e,f,g, using 125MHz marker.

5-35 35-65MHz ADJUSTMENTS

5-36 This procedure adjusts the 35 to 65MHz range. Proceed as follows:

a. Connect equipment as shown in Figure 5-2.

b. Set sweep generator controls as follows:

| | |
|---|---|
| CENTER FREQUENCY | 65MHz |
| ATTENUATION | 23dB |
| SWEEP WIDTH | NARROW |
| Markers on | 1, 10, 50MHz |

c. Set 230B controls as follows:

| | |
|---|---|
| Range | 35-65MHz |
| FREQUENCY MHz | 65MHz |

d. Repeat Steps 5-24 d,e,f, and g using 65MHz marker.

5-37 18.5-35MHz ADJUSTMENT

5-38 This procedure adjusts the 18.5 to 35MHz range. Proceed as follows:

a. Connect equipment as shown in Figure 5-2.

b. Set sweep generator controls as follows:

| | |
|---|---|
| CENTER FREQUENCY | 35MHz |
| ATTENUATION | 26dB |
| Markers on | 1, 10, 50MHz |

c. Set 230B controls as follows:

| | |
|---|---|
| Range | 18.5-35MHz |
| FREQUENCY MHz | 35 |

d. Repeat Steps 5-24 d,e,f,g, using 35MHz marker.

5-39 10-18.5MHz ADJUSTMENT

5-40 This procedure adjusts the 10 to 18.5MHz range. Proceed as follows:

a. Connect equipment as shown in Figure 5-2.

b. Set sweep generator controls as follows:

| | |
|---|---|
| CENTER FREQUENCY | 18MHz |
| ATTENUATION | 26dB |
| Markers on | 1, 10MHz |

c. Set 230B controls as follows:

| | |
|---|---|
| Range | 10-18.5MHz |
| FREQUENCY MHz | 18MHz |

d. Repeat Steps 5-24 d,e,f, and g using 18MHz marker.

5-41 VOLTMETER FULL-SCALE ADJUST

5-42 The following procedure adjusts the accuracy of the RF voltmeter. Proceed as follows:

a. Connect equipment as shown in Figure 5-5.

b. Set sweep generator controls as follows:

| | |
|---|---|
| CENTER FREQUENCY | 10MHz |
| ALC | INT |
| SWEEP WIDTH | CW |
| ATTENUATION | 26dB |
| Markers on | none |

c. Set external RF voltmeter controls as follows:

| | |
|---|---|
| RANGE | 1 Volt |

d. Set 230B controls as follows:

| | |
|---|---|
| Range | 10-18.5MHz |
| FREQUENCY MHz | 10 |
| Voltmeter RANGE | 10 |

e. Adjust 230B VERNIER control for maximum reading on the external RF voltmeter.

f. Adjust sweep generator output for 1.0 Volt reading on external RF voltmeter.

g. Adjust R125, METER SENS, for a full-scale reading on the 230B RF voltmeter 10 Volt range.

## 5-43 COMPONENT REPLACEMENT PROCEDURES

5-44 The following paragraphs give step by step procedures for replacing certain 230B components.

5-45 TUBE REPLACEMENT

5-46 Should it become necessary to replace one or more 2C39A tubes, they should be replaced with HP part number tubes only. These tubes have special reduced size heat radiators for reducing plate to ground capacitance. Proceed as follows:

a. Remove instrument cover and amplifier box top and bottom covers.

b. Refering to Figure 5-7, loosen the plate and grid ring clamps.

c. Slide the plate ring clamp forward until it is free of the plate.

d. Move 2C39A toward rear of amplifier box while moving cathode and filament connectors toward front of amplifier box until they disengage.

e. Remove 2C39A.

f. To replace 2C39A, reverse the above procedure.

**NOTE**

When installing 2C39A, be sure plate contact strap fingers are under plate ring clamp before it is tightened.

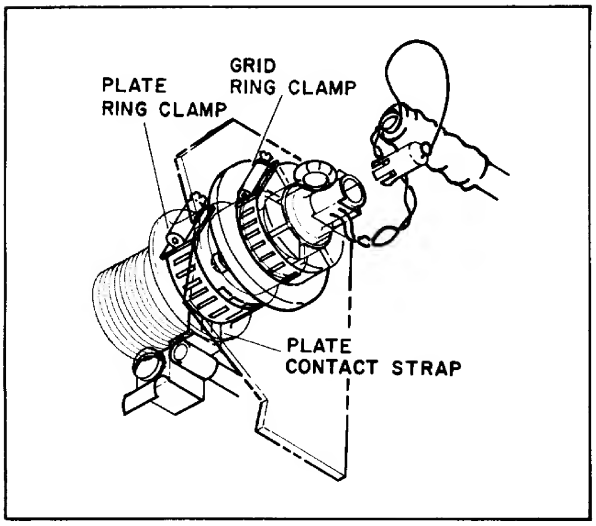



Figure 5-7. 2C39A Removal

5-47 DETECTOR DISASSEMBLY

5-48 Should it become necessary to replace the detector or part of the detector, the following steps should be used in sequence until desired part is removed. (Refer to Figure 5-8.)

a. Unsolder choke from diode lead.

b. Use solder sucker to remove all solder from the center of the feed-through capacitor.

c. Unscrew detector spacer (3).

d. Unsolder both diodes from the line connection (1) being careful not to let solder drip onto the line.

e. Unscrew front panel connector and remove line from detector body (2).

f. Unsolder line from TNC connector.

g. To replace the components, reverse the above procedure.

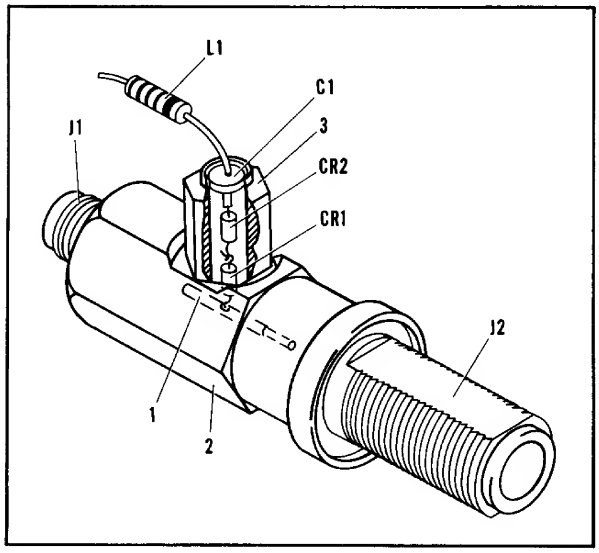



Figure 5-8. Detector Removal

5-49 CAPACITOR PISTON REPLACEMENT

5-50 The following procedure should be used when removing capacitor pistons. Pistons to be reused should be labeled and returned to their original positions. Proceed as follows:

a. Remove instrument cover, right side bracket, and amplifier box top and bottom covers.

b. Turn FREQUENCY MHz control to approximately mid-band.

c. Loosen setscrews on turret adjacent to piston to be removed.

d. Rotate turret on shaft to clear contacts while moving it toward rear of instrument.

e. Remove hex locknut and spacer from piston adjusting screw.

f. Turn adjusting screw clockwise, through hinge pin, until threads disengage.

g. Remove piston from inside amplifier box while exercising care not to damage the ground block spring fingers.

h. To replace piston, reverse the above procedure.

**CAUTION**

When replacing pistons, do not allow the lip on the piston to catch on the glass assembly, as damage may result.

5-51 PISTON MECHANICAL ALIGNMENT

5-52 After removal and replacement of any capacitor pistons, it is necessary to mechanically align them to make electrical adjustment easier. These are approximate settings only and will be readjusted during electrical adjustment.

a. Loosen setscrews adjacent to capacitor piston adjusting screws and set FREQUENCY MHz control to 13MHz.

b. Center hinge plate pins and tighten setscrews.

c. Set FREQUENCY MHz control near 250 MHz on range 5.

d. Align C4, C11, and C18 (long) piston ends with inner edge of silvering on the glass by adjusting piston screws.

e. Turn locknuts finger tight.

f. Set FREQUENCY MHz control near 13.5 MHz.

g. Align C5, C12, and C19 (short) piston ends with inner edge of silvering on the glass by adjusting piston screws.

h. Perform RF adjustments of Paragraphs

5-16 through 5-34.

5-53 CAPACITOR GLASS TUBE REPLACEMENT

5-54 The following is a step by step procedure for replacing capacitor glass tubes. Proceed as follows:

a. Remove instrument cover, right side bracket and amplifier box top and bottom covers.

b. Using procedure in Paragraph 5-26, remove 2C39A tubes.

c. Using the procedure in Paragraph 5-28, remove three pistons from hinge plate over glass tube to be replaced.

d. Remove tension from hinge plate springs with long nosed pliers by moving end of spring sideways until it releases from under lip of amplifier box.

e. Loosen setscrews retaining hinge plate shaft.

f. Move hinge plate shaft toward rear of instrument and remove both shaft and hinge plate.

g. Remove four ground block retaining screws and ground blocks.

h. Unsolder glass tube from terminal inside amplifier box and remove from outside unit.

**CAUTION**

Before reassembling, clean any excess solder from contact straps and any glass tubes to be reused.

i. Replace glass tube, ground block, four retaining screws and lockwashers.

**CAUTION**

Do not solder glass tube and contact strap until after ground block has been tightened or the glass tube may break.

j. Assemble hinge plate and pistons by reversing Steps c through f above.

k. Perform RF Adjustments of Paragraphs 5-16 through 5-34.

5-55 BLOWER MAINTENANCE

5-56 The 230B must always be used with the blower system in operation. For efficient cooling, the filter should be checked periodically and cleaned or replaced if necessary. To service:

a. Remove filter element retainer and filter element.

b. Wash filter element with water and mild detergent, or replace if necessary.

c. Reinstall filter assembly.

## 5-57 LUBRICATION

5-58 After performing repairs, it may be necessary to lubricate the ground block wiper springs and the cam and cam follower. The ground block wiper springs should be lubricated with Supermil ASU Grease M-100 only. The cam and cam follower should be lubricated with "Molykote G".

Supermil ASU Grease M-100 is available from:

American Oil Company
555 Fifth Avenue
New York, New York

Molykote G is available from:

Alpha Molykote Corp.
Stanford, Connecticut

## 5-59 SELECTED COMPONENTS

5-60 The following paragraphs explain the procedures used to determine values of selected components used in the 230B.

5-61 C5, C12, and C19 - selected to compensate for slight variations in capacitance between different instruments.

5-62 Each piston is color coded according to its end diameter (see Figure 5-9). When replacing any of the above pistons, they should be replaced with the same color coded part according to Table 5-2. If the color code cannot be determined, the piston diameter may be checked with a micrometer.

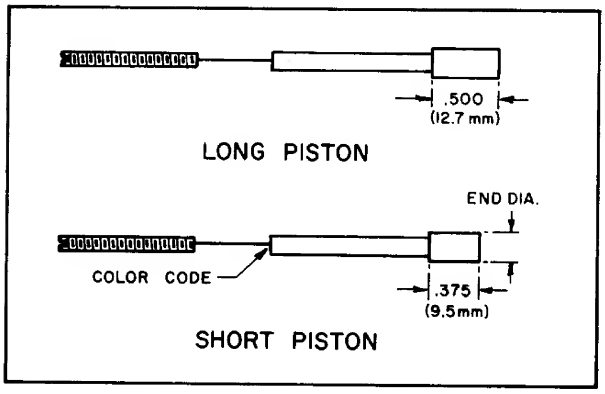



Figure 5-9. Piston Diameters

5-63 Should alignment difficulties be encountered after replacing any of the above pistons and/or

their glass assemblies, additional selection may be necessary. The most common indication is a serious drop in gain around 320MHz. This drop is caused by mis-tracking short pistons. To determine which piston is not tracking properly, proceed as follows:

a. Adjust 230B to frequency at which the gain drops.

b. Turn each piston slightly from its original position while noting if gain increases or decreases.

c. If a significant increase in gain occurs when a piston is turned clockwise, a piston one size larger should be used. If the gain increases when piston is turned counterclockwise, a piston one size larger should be used.

## 5-64 TROUBLESHOOTING

5-65 The voltages shown on the schematic diagram in Figure 7-1 are typical operating voltages and can be used to aid in locating failures. The conditions for measurement are given in Section VII.

5-66 The Performance Checks in Table 5-2 may be used to define problems such as low gain, frequency sensitive or intermittent failures. Causes of frequency sensitive and intermittent failures are too numerous to mention, but most problems in this area are caused by broken or worn contacts in the turret switching assembly. All contacts should be clean and free of grease or dirt. Turret contacts should make positive contact with their corresponding spring contact.

Table 5-2. Short Piston Color Codes

| Part Number | Code/Color | End Diameter |
|---|---|---|
| 00230-80041 | 1 Brown | 0.1951 in.(4.956 mm) |
| 00230-80042 | 2 Red | 0.1952 in.(4.958 mm) |
| 00230-80043 | 3 Orange | 0.1953 in.(4.961 mm) |
| 00230-80044 | 4 Yellow | 0.1954 in.(4.963 mm) |
| 00230-80045 | 5 Green | 0.1955 in.(4.966 mm) |

# SECTION VI
# REPLACEABLE PARTS

## 6-1 INTRODUCTION

6-2 This section contains information for ordering replacement parts.

6-3 Table 6-4 lists parts in alpha-numerical order of the reference designators and provides the following information:

a. Reference Designators. For abbreviations, refer to Table 6-1.

b. Description. Refer to Table 6-2 for abbreviations.

c. Total Quantity (TQ) used in the instrument; given only first time the part number is listed.

d. Manufacturer's part number.

e. Manufacturer's code number. Refer to Table 6-3 for manufacturer's name and address.

f. ℗ Part Number.

g. Recommended spare parts quantity (RS) for complete maintenance of one instrument during one year of isolated service.

h. Parts not identified by a reference designator are listed at the end of Table 6-4 under Miscellaneous.

## 6-4 ORDERING INFORMATION

6-5 To order a replacement part, address order or inquiry to your local Hewlett-Packard sales office (see lists at rear of this manual for addresses).

6-6 Specify the following information for each part:

a. Model and complete serial number of instrument.

b. Hewlett-Packard part number.

c. Circuit reference designator.

d. Description.

6-7 To order a part not listed in Table 6-4, give a complete description of the part and include its function and location.

Table 6-1. Reference Designators

| | |
|---|---|
| A = assembly | CR = diode |
| B = motor | DS = device, signaling (lamp) |
| C = capacitor | E = misc. electronic part |
| F = fuse | J = jack |
| K = relay | L = inductor |
| M = meter | P = plug |
| Q = transistor | R = resistor |
| RT = thermistor | S = switch |
| T = transformer | V = vacuum tube, neon bulb, photocell, etc. |
| X = socket | XF = fuseholder |
| XDS = lampholder | Z = network |

Table 6-2. Description Abbreviations

| | | | |
|---|---|---|---|
| a | = amperes | obd | = order by description |
| c | = carbon | p | = peak |
| cer | = ceramic | pc | = printed circuit board |
| coef | = coefficient | pf | = picofarads = $10^{-12}$ farads |
| com | = common | pp | = peak-to-peak |
| comp | = composition | ppm | = parts per million |
| conn | = connection | pos | = position(s) |
| crt | = cathode-ray tube | poly | = polystyrene |
| dep | = deposited | pot | = potentiometer |
| elect | = electrolytic | prv | = peak reverse voltage |
| encap | = encapsulated | rect | = rectifier |
| f | = farads | rot | = rotary |
| fxd | = fixed | rms | = root-mean-square |
| GE | = germanium | s-b | = slow-blow |
| grd | = ground(ed) | sect | = section(s) |
| h | = henries | Si | = silicon |
| Hg | = mercury | sil | = silver |
| impg | = impregnated | sl | = slide |
| ins | = insulation(ed) | td | = time delay |
| K | = kilo = 1000 | $TiO_2$ | = titanium dioxide |
| lin | = linear taper | tog | = toggle |
| log | = logarithmic taper | tol | = tolerance |
| mA | = milli = $10^{-3}$ | trim | = trimmer |
| M | = megohms | twt | = traveling wave tube |
| ma | = milliamperes | var | = variable |
| μ | = micro = $10^{-6}$ | w/ | = with |
| mfr | = manufacturer | W | = watts |
| mtg | = mounting | w/o | = without |
| my | = mylar | cmo | = cabinet mount only |
| NC | = normally closed | | |
| Ne | = neon | | |
| NO | = normally open | | |

Table 6-3. Code List of Manufacturers

| CODE NO. | MANUFACTURER | ADDRESS |
|---|---|---|
| 00629 | EBY Sales Co. | New York, N.Y. |
| 00656 | Aerovox Corp. | New Bedford, Mass. |
| 00853 | Sangamo Electric Company, Ordill Division (Capacitors) | Marion, Ill. |
| 01121 | Allen Bradley Co. | Milwaukee, Wis. |
| 01255 | Litton Industries, Inc. | Beverly Hills, Calif. |
| 01281 | TRW Semiconductors, Inc. | Lawndale, Calif. |
| 01295 | Texas Instruments, Inc. Semiconductor-Components Division | Dallas, Texas |
| 01686 | RCL Electronics, Inc. | Manchester, N.H. |
| 01930 | Amerock Corp. | Rockford, Ill. |
| 02114 | Ferroxcube Corp. of America | Saugerties, N.Y. |
| 02606 | Fenwal Laboratories | Morton Grove, Ill. |
| 02660 | Amphenol-Borg Electronics Corp. | Broadview, Ill. |
| 02735 | Radio Corp. of America, Commercial Receiving Tube and Semiconductor Div. | Somerville, N.J. |
| 03508 | G.E. Semiconductor Products Dept. | Syracuse, N.Y. |
| 03797 | Eldema Corp. | Compton, Calif. |
| 03877 | Transitron Electronic Corp. | Wakefield, Mass. |
| 03888 | Pyrofilm Resistor Co. | Cedar Knolls, N.J. |
| 04009 | Arrow, Hart and Hegeman Electric Co. | Hartford, Conn. |
| 04072 | ADC Electronics, Inc. | Harbor City, Calif. |
| 04213 | Caddell-Burns Mfg. Co. Inc. | Mineola, N.Y. |
| 04404 | Dymec Division of Hewlett-Packard Co. | Palo Alto, Calif. |
| 04713 | Motorola, Inc., Semiconductor Products Division | Phoenix, Arizona |
| 05277 | Westinghouse Electric Corp. Semi-Conductor Dept. | Youngwood, Pa. |
| 05347 | Ultronix, Inc. | Grand Junction, Colo. |
| 05820 | Wakefield Engr. Inc. | Wakefield, Mass. |
| 06004 | The Bassick Co. | Bridgeport, Conn. |
| 06486 | IRC, Inc. Semiconductor Div. | Lynn, Mass. |
| 06540 | Amathom Electronic Hardware Co., Inc. | New Rochelle, N.Y. |
| 06555 | Beede Electrical Instrument Co., Inc. | Penacook, N.H. |
| 06666 | General Devices Co., Inc. | Indianapolis, Ind. |
| 06751 | Nuclear Corp. of America, Inc. U.S. Semcor Div. | Phoenix, Arizona |
| 06812 | Torrington Mfg. Co., West Div. | Van Nuys, Calif. |
| 07137 | Transistor Electronics Corp. | Minneapolis, Minn. |
| 07138 | Westinghouse Electric Corp. Electronic Tube Div. | Elmira, N.Y. |
| 07263 | Fairchild Semiconductor Div. of Fairchild Camera and Instrument Corp. | Mountain View, Calif. |
| 07387 | Birtcher Corp., The | Los Angeles, Calif. |
| 07397 | Sylvania Electric Products Inc. Mountain View Operations of Sylvania Electronic Systems | Mountain View, Calif. |
| 07716 | I. R. C. Inc. | Burlington, Iowa |
| 07910 | Continental Device Corp. | Hawthorne, Calif. |
| 07933 | Raytheon Mfg. Co., Semiconductor Div. | Mountain View, Calif. |
| 08484 | Breeze Corporations, Inc. | Union, N.J. |
| 08530 | Reliance Mica Corp. | Brooklyn, N.Y. |
| 08717 | Sloan Company | Sun Valley, Calif. |
| 08730 | Vemaline Products Co. | Franklin Lakes, N.J. |
| 08863 | Nylomatic Corp. | Morrisville, Pa. |
| 09021 | Airco Speer Electronic Components | Bradford, Pa. |
| 09182 | Hewlett-Packard Co., New Jersey Div. | Berkeley Heights, N.J. |
| 09353 | C & K Components | Newton, Mass. |
| 09922 | Burndy Corp. | Norwalk, Conn. |
| 11236 | CTS of Berne, Inc. | Berne, Ind. |
| 11237 | Chicago Telephone of California, Inc. | So. Pasadena, Calif. |
| 11502 | IRC Inc. | Boone, N.C. |
| 11711 | General Instrument Corp., Semiconductor Prod. Group, Rectifier Div. | Newark, N.J. |
| 12136 | Philadelphia Handle Co., Inc. | Camden, N.J. |
| 12615 | U.S. Terminals, Inc. | Cincinnati, Ohio |
| 12617 | Hamlin Inc. | Lake Mills, Wisconsin |
| 12697 | Clarostat Mfg. Co. | Dover, N.H. |
| 14493 | Hewlett-Packard Co., Loveland Division | Loveland, Colo. |
| 14655 | Cornell-Dubilier Elec. Corp. | Newark, N.J. |
| 14936 | General Instrument Corp., Semiconductor Prod. Group, Semiconductor Div. | Hicksville, N.Y. |
| 15909 | Daven Div. of Thos. Edison Industries, Mc Graw Edison Co. | Livingston, N.J. |
| 16299 | Corning Glass Works, Electronic Components Div. | Raleigh, N.C. |
| 16758 | Delco Radio Div. of General Motors Corp. | Kokomo, Ind. |
| 17545 | Atlantic Semiconductors, Inc. | Asbury Park, N.J. |
| 17803 | Fairchild | Mountainview, Calif. |
| 19315 | The Bendix Corp., Eclipse Pioneer Div. | Teterboro, N.J. |
| 19701 | Electra Mfg. Co. | Independence, Kan. |

Table 6-3. Code List of Manufacturers (Continued)

| CODE NO. | MANUFACTURER | ADDRESS |
|---|---|---|
| 21520 | Fansteel Metallurgical Corp. | No. Chicago, Ill. |
| 22229 | Union Carbide Corp., Linde Div., Kemet Dept. | Mountain View, Calif. |
| 22767 | ITT Semiconductors, A Division of International Telephone & Telegraph Corp. | Palo Alto, Calif. |
| 24446 | General Electric Co. | Schenectady, N.Y. |
| 24455 | General Electric Co., Lamp Division | Nela Park, Cleveland, Ohio |
| 24655 | General Radio Co. | West Concord, Mass. |
| 26982 | Dynacool Mfg. Co. Inc | Saugerties, N.Y. |
| 27014 | National Semiconductor Corp. | Santa Clara, Calif. |
| 28480 | Hewlett-Packard Co. | Palo Alto, Calif. |
| 28520 | Heyman Mfg. Co. | Kenilworth, N.J. |
| 33173 | G.E., Tube Dept. | Owensboro, Ky. |
| 35434 | Lectrohm, Inc. | Chicago, Ill. |
| 37942 | P. R. Mallory & Co., Inc. | Indianapolis, Ind. |
| 42190 | Muter Co. | Chicago, Ill. |
| 43334 | New Departure-Hyatt Bearings Div., General Motors Corp. | Sandusky, Ohio |
| 44655 | Ohmite Manufacturing Co. | Skokie, Ill. |
| 46384 | Penn Engr. | Doylestown, Pa. |
| 47904 | Polaroid Corp. | Cambridge, Mass. |
| 49956 | Raytheon Mfg. Co., Microwave and Power Tube Div. | Waltham, Mass. |
| 55026 | Simpson Electric Co. | Chicago, Ill. |
| 56289 | Sprague Electric Co. | North Adams, Mass. |
| 58474 | Superior Electric Co. | Bristol, Conn. |
| 61637 | Union Carbide Corp. | New York, N.Y. |
| 63743 | Ward-Leonard Electric Co. | Mt. Vernon, N.Y. |
| 70563 | Amperite Co., Inc. | Union City, N.J. |
| 70901 | Beemer Engrg. Co. | Fort Washington, Pa. |
| 70903 | Belden Mfg. Co. | Chicago, Ill. |
| 71218 | Bud Radio, Inc. | Willoughby, Ohio |
| 71279 | Cambridge Thermionic Corp. | Cambridge, Mass. |
| 71400 | Bussmann Mfg. Div. of Mc Graw-Edison Co. | St. Louis, Mo. |
| 71450 | CTS Corporation | Elkhart, Ind. |
| 71468 | I. T. T. Cannon Electric Inc. | Los Angeles, Calif. |
| 71590 | Centralab Div. of Globe Union, Inc. | Milwaukee, Wis. |
| 71700 | The Cornish Wire Co. | New York, N.Y. |
| 71707 | Coto-Coil | Providence, R.I. |
| 71744 | Chicago Miniature Lamp Works | Chicago, Ill. |
| 71785 | Cinch Mfg. Co. | Chicago, Ill. |
| 71984 | Dow Corning Corp. | Midland, Mich. |
| 72136 | Electro-Motive Mfg. Co. Inc., The | Willimantic, Conn. |
| 72619 | Dialight Corp. | Brooklyn, N.Y. |
| 72699 | General Instrument Corp., Capacitor Div. | Newark, N.J. |
| 72765 | Drake Mfg. Co. | Chicago, Ill. |
| 72962 | Elastic Stop Nut Corp. of America | Union, N.J. |
| 72982 | Erie Technological Products, Inc. | Erie, Pa. |
| 73138 | Helipot Div. of Beckman Instruments, Inc. | Fullerton, Calif. |
| 73168 | Fenwal, Inc. | Ashland, Mass. |
| 73293 | Hughes Components Division of Hughes Aircraft Co. | Newport Beach, Calif. |
| 73445 | Amperex Electronic Co., Div. of North American Phillips Co., Inc. | Hicksville, N.Y. |
| 73506 | Bradley Semiconductor Corp. | New Haven, Conn. |
| 73559 | Carling Electric, Inc. | Hartford, Conn. |
| 73734 | Federal Screw Porducts, Inc. | Chicago, Ill. |
| 73978 | Hardwick Hindle Co., Memcor Components Div. | Huntington, Ind. |
| 74193 | Heinemann Electric Co. | Trenton, N.J. |
| 74545 | Harvey Hubbel, Inc. | Bridgeport, Conn. |
| 74868 | FXR Div. of Amphenol-Borg Electronics Corp. | Danbury, Conn. |
| 74970 | E. F. Johnson Co. | Waseca, Minn. |
| 75042 | International Resistance Co. | Philadelphia, Pa. |
| 75183 | Howard B. Jones Div., of Cinch Mfg. Corp. (Use 71785) | New York, N.Y. |
| 75382 | Kulka Electric Corp. | Mt. Vernon, N.Y. |
| 75915 | Littlefuse, Inc. | Des Plaines, Ill. |
| 76381 | Minnesota, Mining & Mfg. Co. | St. Paul, Minn. |
| 76493 | J. W. Miller Co. | Los Angeles, Calif. |
| 76530 | Cinch | City of Industry, Calif. |
| 76854 | Oak Manufacturing Co. | Crystal Lake, Ill. |
| 77068 | Bendix Corp., Bendix-Pacific Div. | No. Hollywood, Calif. |
| 77147 | Patton Mac Guyer Co. | Providence, R.I. |
| 77221 | Phaostron Instrument and Electronic Co. | South Pasadena, Calif. |
| 77252 | Philadelphia Steel and Wire Corp. | Philadelphia, Pa. |
| 77342 | American Machine and Foundry, Potter and Brumfield Div. | Princeton, Ind. |
| 77630 | TRW Electronics, Components Div. | Camden, N.J. |
| 77764 | Resistance Products Co. | Harrisburg, Pa. |
| 78189 | Shakeproof Div. of Illinois Tool Works | Elgin, Ill. |
| 78452 | Everlock Chicago, Inc. | Chicago, Ill. |
| 78488 | Stackpole Carbon Co. | St. Marys, Pa. |
| 78526 | Stanwyck Winding Co., Inc. | Newburgh, N.Y. |
| 78553 | Tinnerman Products, Inc. | Cleveland, Ohio |

Table 6-3. Code List of Manufacturers (Continued)

| CODE NO. | MANUFACTURER | ADDRESS |
|---|---|---|
| 78584 | Stewart Stamping Corp. | Yonkers, N.Y. |
| 79136 | Waldes Kohinoor, Inc. | L.I.C., N.Y. |
| 79307 | Whitehead Metal Products Co., Inc. | New York, N.Y. |
| 79727 | Continental-Wirt Electronics Corp. | Philadelphia, Pa. |
| 80031 | Mepco Div. of Sessions Clock Co. | Morristown, N.J. |
| 80294 | Bourns, Inc. | Riverside, Calif. |
| 81042 | Howard Industries, Inc. | Racine, Wis. |
| 81483 | International Rectifier Corp. | El Segundo, Calif. |
| 81751 | Columbus Electronics Corp. | Yonkers, N.Y. |
| 82099 | Goodyear Sundries & Mechanical Co., Inc. | New York, N.Y. |
| 82142 | Airco Speer Electronic Components | Du Bois, Pa. |
| 82219 | Sylvania Electric Products, Inc., Electronic Tube Division | Emporium, Pa. |
| 82389 | Switchcraft, Inc. | Chicago, Ill. |
| 82647 | Metals and Controls, Inc., Spencer Products | Attleboro, Mass. |
| 82866 | Research Products Corp. | Madison, Wis. |
| 82877 | Rotron Mfg. Co., Inc. | Woodstock, N.Y. |
| 82893 | Vector Electronic Co. | Glendale, Calif. |
| 83058 | Carr Fastener Co. | Cambridge, Mass. |
| 83186 | Victory Engineering Corp. | Springfield, N.J. |
| 83298 | Bendix Corp., Red Bank Div. | Eatontown, N.J. |
| 83330 | Herman H. Smith, Inc. | Brooklyn, N.Y. |
| 83385 | Central Screw Co. | Chicago, Ill. |
| 83501 | Gavitt Wire and Cable Co., Div. of Amerace Corp. | Brookfield, Mass. |
| 83508 | Grant Pulley and Hardware Co. | West Nyack, N.Y. |
| 83594 | Burroughs Corp., Electronic Components Div. | Plainfield, N.J. |
| 83835 | U.S. Radium Corp. | Morristown, N.J. |
| 83877 | Yardeny Laboratories, Inc. | New York, N.Y. |
| 84171 | Arco Electronics, Inc. | Great Neck, N.Y. |
| 84411 | TRW Capacitor Div. | Ogallala, Neb. |
| 86684 | Radio Corp. of America, Electronic Components & Devices Div. | Harrison, N.J. |
| 86838 | Rummel Fibre Co. | Newark, N.J. |
| 87034 | Marco Industries Co. | Anaheim, Calif. |
| 87216 | Philco Corp. (Lansdale Div.) | Lansdale, Pa. |
| 87585 | Stockwell Rubber Co., Inc. | Philadelphia, Pa. |
| 87929 | B.M. Tower Co., Inc. | Bridgeport, Conn. |
| 88140 | Cutler-Hammer, Inc. | Lincoln, Ill. |
| 89473 | General Electric Distributing Corp. | Schenectady, N.Y. |
| 91345 | Miller Dial and Nameplate Co. | El Monte, Calif. |
| 91637 | Dale Electronics, Inc. | Columbus, Neb. |
| 91662 | Elco Corp. | Willow Grove, Pa. |
| 91929 | Honeywell, Inc., Micro Switch Div. | Freeport, Ill. |
| 93332 | Sylvania Electric Prod., Inc., Semiconductor Prod. Div. | Woburn, Mass. |
| 93410 | Stevens Mfg. Co., Inc. | Mansfield, Ohio |
| 94144 | Raytheon Co., Components Div., Industrial Components Operation | Quincy, Mass. |
| 94154 | Tung-Sol Electric, Inc. | Newark, N.J. |
| 94222 | South Chester Corp. | Chester, Pa. |
| 94310 | Tru-Ohm Products, Memcor Components Div. | Huntington, Ind. |
| 95263 | Leecraft Mfg. Co., Inc. | Long Island City, N.Y. |
| 95354 | Methode Mfg. Co. | Chicago, Ill. |
| 95712 | Bendix Corp, Microwave Div. | Franklin, Ind. |
| 96791 | Amphenol Controls Div. of Amphenol-Borg Electronics Corp. | Janesville, Wis. |
| 97464 | Industrial Retaining Ring Co. | Irvington, N.J. |
| 98291 | Sealectro Corp. | Mamaroneck, N.Y. |
| 98978 | International Electronic Research Corp. | Burbank, Calif. |
| 99934 | Renbrandt, Inc. | Boston, Mass. |

THE FOLLOWING H-P VENDORS HAVE NO NUMBERS ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

| | | |
|---|---|---|
| 0000 | Cooltron | Oakland, Calif. |
| 00000 | Plastic Ware Co. | Brooklyn, N.Y. |

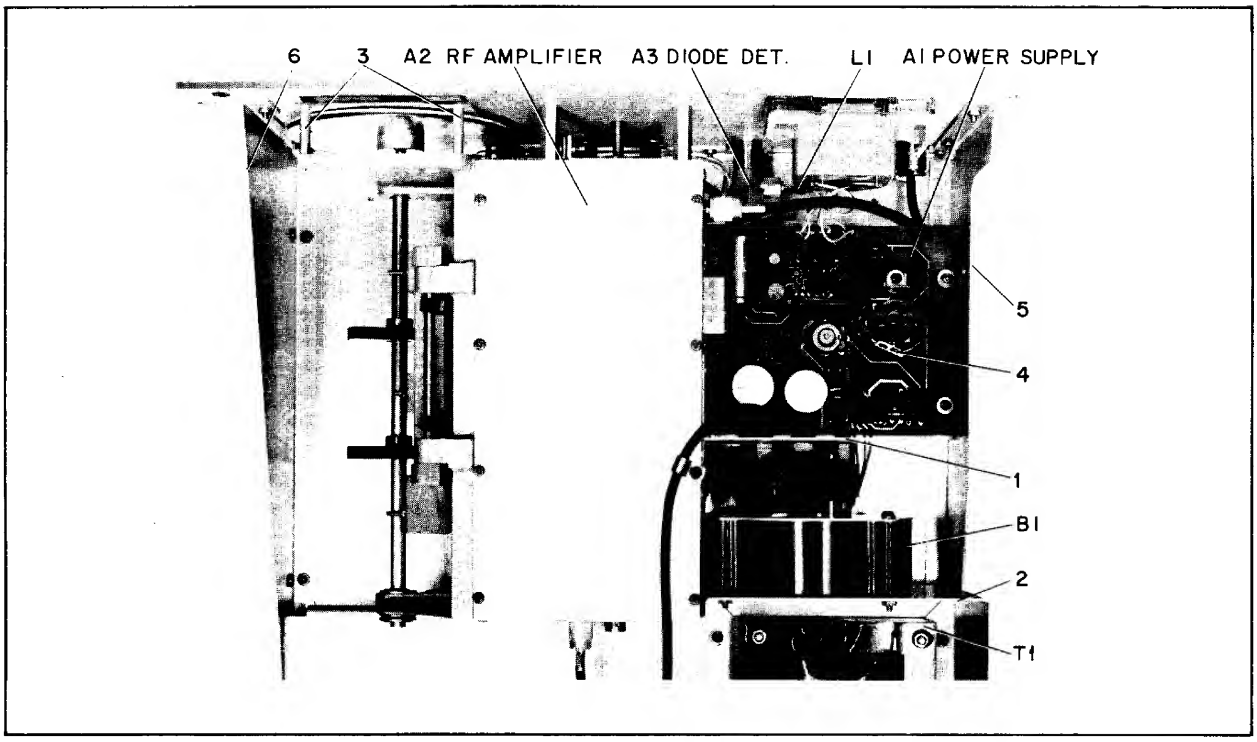



Figure 6-1. Overall Component Location

| ITEM NO. | DESCRIPTION | TQ | MFR. PART NO. | MFR. CODE | ℗ PART NO. | RS |
|---|---|---|---|---|---|---|
| 1-1 | Mounting Bracket, Fan Motor | 1 | | 09182 | 00230-01016 | - |
| 1-2 | Bracket, Fan Mounting | 1 | | 09182 | 00230-01006 | - |
| - | Spacer, P.C. Board | 1 | 2112 | 83330 | 0380-0786 | 1 |
| - | Panel, Front | 1 | | 09182 | 00230-01004 | - |
| - | Knob, Frequency (Black) | 1 | | 09182 | 0370-0028 | 1 |
| - | Knob, Meter Range | 1 | | 09182 | 0370-0112 | 1 |
| - | Knob, Frequency, Range | 1 | | 09182 | 0370-0035 | 1 |
| - | Knob, Vernier | 1 | | 09182 | 0370-0025 | 1 |
| - | Handle, 7" | 2 | | 09182 | 5020-5584 | 1 |
| - | Meter, Bezel | 1 | | 09182 | 4040-0296 | 1 |
| - | Spring, Meter | 4 | | 09182 | 1460-0256 | 1 |
| 1-3 | Spacer, Fiducial (spacer holding fiducial to casting) | 1 | | 09182 | 00250-20115 | |
| 1-4 | Clamp, Tube | 1 | 926C | 07387 | 1400-0196 | 1 |
| - | Cabinet Assembly | 1 | | 09182 | 00230-61001 | - |
| 1-5 | Bracket, Left Side | 1 | | 09182 | 00230-01001 | - |
| 1-6 | Bracket, Right Side | 1 | | 09182 | 00230-01002 | - |
| - | Filter Assembly, Air | 1 | | 09182 | 5060-0878 | - |
| - | Chassis | 1 | | 09182 | 00230-01005 | - |
| - | Cover, Bottom | 1 | | 09182 | 00230-01003 | - |
| - | Foot, Rubber | 4 | 4-1/2 CB | 76385 | 0403-0045 | 1 |
| - | Holder, Fuse | 1 | 342014 | 75915 | 1400-0084 | 1 |
| - | Lock Washer Helical Spring Type | - | | 09182 | 2190-0086 | - |
| - | Nut, Knurled 5/8 x 24 thread 3/4 in. O.D. | - | | 09182 | 0590-0011 | - |

Table 6-4. Replaceable Parts

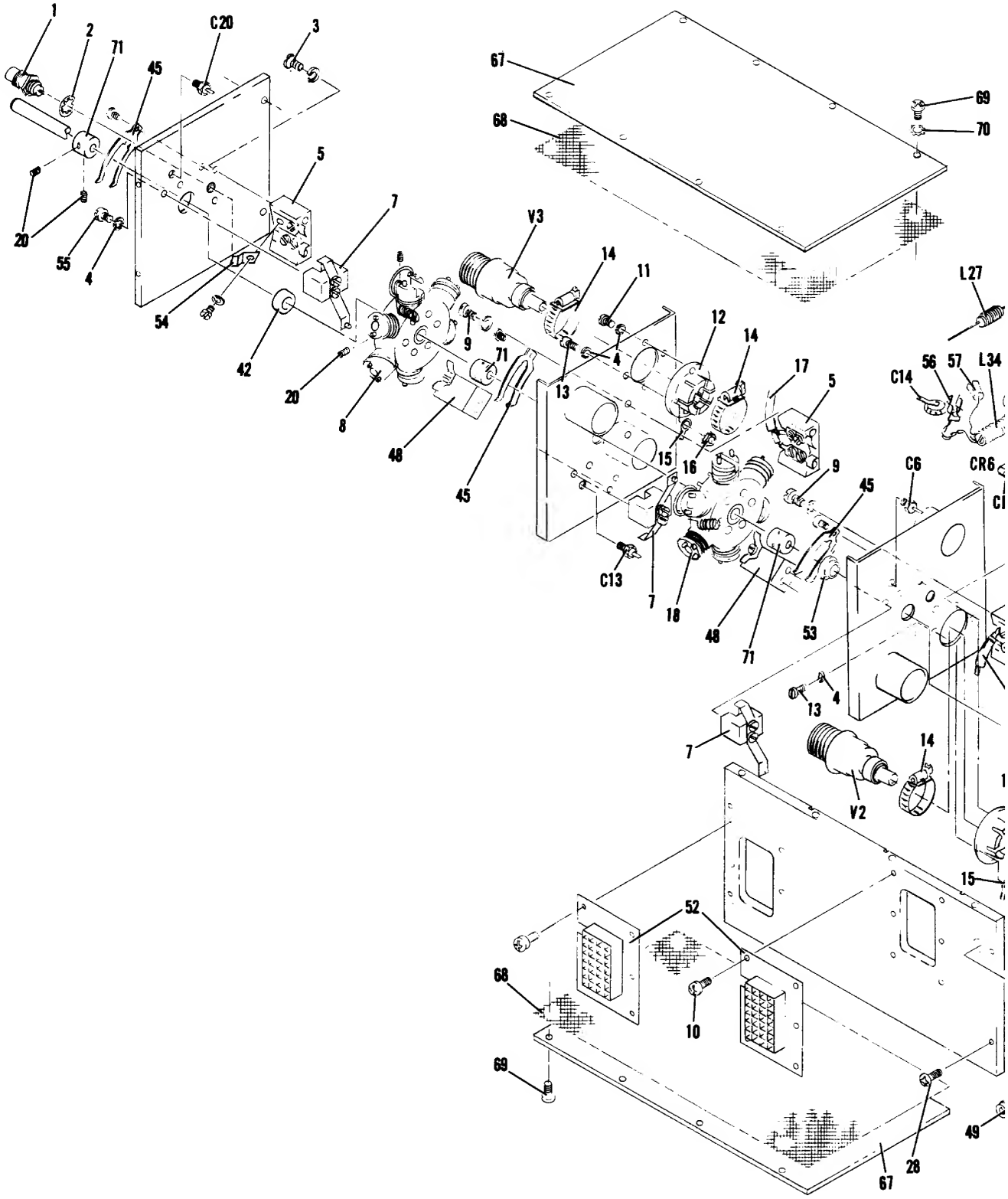
| REF. DESIG. | DESCRIPTION | TQ | MFR. PART NO. | MFR. CODE | ℗ PART NO. | RS |
|---|---|---|---|---|---|---|
| | CHASSIS ELECTRICAL PARTS | | | | | |
| B1 | Motor, Fan | | | 09182 | 3160-0215 | |
| C1 | fxd, ceramic 10,000pF ±20% 250Vac | 1 | 41C157-CDH | 56289 | 0150-0123 | 1 |
| C2, C3 | fxd, ceramic 0.002μf ±20% 250Vac | 2 | 19C253 | 56289 | 0160-2108 | 1 |
| DS1 | Light, Indicator (Red) | 1 | 599-124 | 72765 | 1450-0048 | 1 |
| F1 (115Vac) | Fuse, 2A 125V S. B. | 1 | 313.002 | 75915 | 2110-0006 | 5 |
| F1 (230Vac) | Fuse, 1A 125V S. B. | 1 | 313.001 | 75915 | 2110-0007 | 5 |
| M1 | Meter, 0-3, 0-10, 0-30 RF Volts | 1 | | 09182 | 1120-0413 | 1 |
| P6 | AC Power Connector | 1 | | 09182 | 1251-2357 | 1 |
| R1 | fxd, comp 43KΩ ±5% ½W | 1 | EB-4335 | 01121 | 0686-4335 | 1 |
| S1 | Toggle Switch, SPST | 1 | 80994-HB | 04009 | 3101-0001 | 1 |
| S2 | Slide Switch, DPDT | 1 | G326-0001 | 79727 | 3101-0033 | 1 |
| S3 | Meter Switch | 1 | | 09182 | 3100-1612 | 1 |
| T1 | Transformer, Power | 1 | | 09182 | 00230-80501 | 1 |
| W1 | Input Cable Assembly | 1 | | 09182 | 00230-61004 | 1 |
| W7 | AC Power Cord | 1 | | 09182 | 8120-1348 | 1 |
| A1 | Main P. C. Board (Loaded) | 1 | | 09182 | 00230-61020 | 1 |
| A1C1 | fxd, ceramic 0.02μf ±20% 2000WVdc | 1 | 41C321-CDH | 56289 | 0160-2569 | 1 |
| A1C2 | fxd, elect. 40μf 500WVdc +50 -10% | 2 | 68D10031-DFP | 56289 | 0180-2226 | 1 |
| A1C3 | fxd, mylar 0.1μf ±10% 200WVdc | 1 | 192P10492-PTS | 56289 | 0160-0168 | 1 |
| A1C4 | fxd, elect. 10μf 450WVdc +50 -10% | 1 | | 09182 | 0180-1944 | 1 |
| A1C6 | fxd, ceramic 0.02μf 25WVdc | 1 | 5835Y5U203Z | 72982 | 0160-2605 | 1 |
| A1C7 | fxd, elect. 40μf 500WVdc +50 -10% | | 68D10031-DFP | 56289 | 0180-2226 | |
| A1CR1-CR4 | Diode, Si. 800PIV | 4 | 34534 | 02735 | 1901-0388 | 4 |
| A1CR5 | Diode, Si. | 1 | | 09182 | 1901-0040 | 1 |
| A1CR7 | Diode, Si. 50PIV | 1 | | 09182 | 1901-0049 | 1 |
| A1Q1 | SS NPN Si. | 1 | | 09182 | 1854-0087 | 1 |
| A1Q2 | SS NPN Si. | 1 | | 09182 | 1854-0244 | 1 |
| A1R1 | fxd, comp 180KΩ ±5% ½W | 1 | EB-1845 | 01121 | 0686-1845 | 1 |
| A1R2 | fxd, comp 56KΩ ±5% ½W | 1 | EB-5635 | 01121 | 0686-5635 | 1 |
| A1R3 | fxd, met. ox. 15KΩ ±5% 4W ±250ppm | 1 | Type PMF-4 | 07716 | 0770-0006 | 1 |
| A1R4 | fxd, film 261KΩ ±1% 1/8W ±100ppm | 1 | Type CEA | 07716 | 0698-3455 | 1 |
| A1R5 | fxd, film 200KΩ ±1% 1/8W ±100ppm | 1 | Type CEA | 07716 | 0757-0472 | 1 |
| A1R6 | fxd, comp 27KΩ ±5% ½W | 1 | EB-2735 | 01121 | 0686-2735 | 1 |
| A1R7 | fxd, met. ox. 68KΩ ±5% 1W ±200ppm | 1 | L32 | 07716 | 0761-0083 | 1 |
| A1R8 | fxd, met. ox. 5.60KΩ ±5%4W ±250ppm | 1 | Type PMF-4 | 07716 | 0770-0011 | 1 |
| A1R9 | fxd, comp 300KΩ ± % ½W | 1 | EB-3045 | 01121 | 0686-3045 | 1 |
| A1R10 | fxd, comp 2MΩ ±5% ½W | 1 | EB-2055 | 01121 | 0686-2055 | 1 |
| A1R11 | fxd, comp 1.5MΩ ±5% ½W | 1 | EB-1555 | 01121 | 0686-1555 | 1 |
| A1R12 | fxd, comp 4.7KΩ ±5% ½W | 2 | EB-4725 | 01121 | 0686-4725 | 1 |
| A1R13 | var. ww 10KΩ ±10% | 1 | Type 500 | 75042 | 2100-1776 | 1 |
| A1R14 | fxd, comp 4.7KΩ ±5% ½W | | EB-4725 | 01121 | 0686-4725 | |
| A1R15 | fxd, film 33.2KΩ ±1% 1/8W ±100ppm | 1 | Type CEA | 07716 | 0757-0454 | 1 |
| A1R16 | fxd, film 107KΩ ±1% 1/8W ±100ppm | 1 | Type CEA | 07716 | 0698-4515 | 1 |
| A1R17 | fxd, film 340KΩ ±1% 1/8W ±100ppm | 1 | Type CEA | 07716 | 0698-4536 | 1 |
| A1R18 | var. ww 100KΩ ±30% | 1 | | 09182 | 2100-0095 | 1 |
| A1R19 | fxd, comp 10KΩ ±5% ½W | 1 | EB-1035 | 01121 | 0686-1035 | 1 |
| A1R21 | fxd, comp 100Ω ±5% ¼W | 1 | CB-1015 | 01121 | 0683-1015 | 1 |
| A1V1 | Electron Tube, Dual Triode | 1 | 6AS7G | 02735 | 1932-0018 | 1 |
| A1V2 | Electron Tube, Pentode | 1 | 6AU6 | 02735 | 1923-0021 | 1 |
| A1V3 | Electron Tube | 1 | OA2 | 02735 | 1940-0004 | 1 |
| A1VR6 | Diode, Zener 43.2V ±2% | 1 | | 09182 | 1902-3327 | 1 |

| ITEM NO. | DESCRIPTION | TQ | MFR. PART NO. | MFR. CODE | ℗ PART NO. | RS |
|---|---|---|---|---|---|---|
| | PC BOARD 00230-61020<br>MECHANICAL PARTS | | | | | |
| - | Bracket, P.C. Board | 2 | | 09182 | 00230-01015 | 1 |
| - | Heat Dissipator, Semiconductor | 1 | NF-207 | 05820 | 1205-0033 | 1 |
| - | Socket, Tube (V1) | 1 | 101-04-11-100 | 71785 | 1200-0084 | 1 |
| - | Socket, Tube (V2, V3) | 2 | 111-51-11-069 | 71785 | 1200-0053 | 2 |
| - | Tube Clamp (V1) | 1 | | 09182 | 1400-0196 | 1 |
| - | Spacer, Tube Clamp | 1 | | 09182 | 0380-0786 | 1 |

| REF. DESIG. | DESCRIPTION | TQ | MFR. PART NO. | MFR. CODE | hp PART NO. | RS |
|---|---|---|---|---|---|---|
| A2 | Amplifier Box Assembly (Loaded) | 1 | | 09182 | 00230-61002 | 1 |
| A2C1 | fxd, mica 1000pf ±10% | 3 | | 09182 | 0160-0428 | 1 |
| A2C2, C3 | fxd, ceramic feed-thru, 1000pf +100 -0%, 500WVdc | 10 | FB2B-102W | 01121 | 0160-0345 | 2 |
| A2C4, 5, 11, 12, 18, 19 | See Paragraph 5-59 | - | - | - | - | - |
| A2C6 | fxd, ceramic 1000pf -20, +80%, 500WVdc | 3 | SB4A | 01121 | 0160-0420 | 1 |
| A2C7 | fxd, mica 1000pf ±10% | | | 09182 | 0160-0428 | |
| A2C8-C10 | fxd, ceramic feed-thru, 1000pf +100 -0%, 500WVdc | | FB2B-102W | 01121 | 0160-0345 | |
| A2C13 | fxd, ceramic 1000pf -20, +80%, 500WVdc | | SB4A | 01121 | 0160-0420 | |
| A2C14 | fxd, mica 1000pf ±10% | | | 09182 | 0160-0428 | |
| A2C15-C17 | fxd, ceramic feed-thru, 1000pf, +100 -0%, 500WVdc | | FB2B-102W | 01121 | 0160-0345 | |
| A2C20 | fxd, ceramic 1000pf -20, +80%, 500WVdc | | SB4A | 01121 | 0160-0420 | |
| A2C21 | fxd, ceramic feed-thru, 1000pf, +100 -0%, 500WVdc | | FB2B-102W | 01121 | 0160-0345 | |
| A2C22-28 | NOT ASSIGNED | - | - | - | - | - |
| A2C29, 35, 36-38 | fxd, ceramic 4700pf ±20% | 5 | DD472 | 71590 | 0160-0472 | 1 |
| A2C39 | fxd, ceramic feed-thru, 1000pf, +100 -0%, 500WVdc | | FB2B-102W | 01121 | 0160-0345 | |
| A2CR1, 5, 6 | Diode, Si. 50PIV | 3 | | 09182 | 1901-0049 | 3 |
| A2J1 | NOT ASSIGNED | - | - | - | - | - |
| A2J2, 3 | RF Connector, TNC | 2 | | 09182 | 1250-0794 | 1 |
| A2L9, 18, 27, 30, 31 | Choke Assembly | 5 | | 09182 | 00230-80006 | 1 |
| A2L34 | Choke | 1 | | 09182 | 00230-60052 | 1 |
| A2L35 | Choke | 1 | | 09182 | 00230-60051 | 1 |
| A2L36 | Choke | 1 | | 09182 | 00230-60050 | 1 |
| A2V1-V3 | Electron Tube, 2 C39A, Triode | 3 | | 09182 | 1921-0046 | 3 |
| A2W2 | Output Cable | 1 | | 09182 | 00230-61005 | 1 |
| A2Z1 | Turret Assembly | 2 | | 09182 | 00230-60021 | 2 |
| A2Z2 | Turret Assembly | 1 | | 09182 | 00230-60026 | 1 |
| A2Z3 | Turret Assembly | | | 09182 | 00230-60021 | |
| A3 | RF Detector (Loaded) | 1 | | 09182 | 00230-61003 | 1 |
| A3C1 | fxd, cer. feed-thru 220pf ±20% 300Vdc | 1 | FW5N-2212 | 01121 | 0160-2603 | 1 |
| A3CR1, CR2 | Diode | 2 | | 09182 | 1901-0518 | 2 |
| A3J1 | RF Connector (with cable) | 1 | 2684-3 | 95712 | 1250-2041 | 1 |
| A3J2 | RF Connector, TNC | 1 | 8306-1 | 95712 | 1250-0794 | 1 |
| A3L1 | Inductor, shielded 100μh ±10% | 1 | 15S-101K | 82142 | 9100-2562 | 1 |
| | RF DETECTOR MECHANICAL PARTS (Refer to Figure 5-8) | | | | | |
| | Detector line | 1 | | 09182 | 00230-21007 | 1 |
| | Detector body | 2 | | 09182 | 00230-21006 | 1 |
| | Detector spacer | 3 | | 09182 | 00230-21008 | 1 |

| ITEM NO. | DESCRIPTION | TQ | MFR. PART NO. | MFR. CODE | ℎ PART NO. | RS |
|---|---|---|---|---|---|---|
| | RF BOX MECHANICAL PARTS | | | | | |
| 2-1 | RF Connector | 1 | 8306-1 | 95712 | 1250-0794 | 1 |
| 2-2 | Lock Washer | - | 1920-02 | 78189 | 2190-0016 | - |
| 2-3 | Machine Screw | - | | 09182 | 2200-0145 | - |
| 2-4 | Lock Washer | - | | 09182 | 2190-0086 | - |
| 2-5 | Block & Contact Ass'y (see Fig. 6-7) | 3 | | 09182 | - | 1 |
| 2-6 | NOT ASSIGNED | - | - | - | - | - |
| 2-7 | Block & Contact Ass'y (see Fig. 6-5) | 3 | | 09182 | - | 1 |
| 2-8 | Turret Assembly (Z1,Z3) | 2 | | 09182 | 00230-60021 | 1 |
| 2-9 | Machine Screw | - | | 09182 | 2200-0141 | - |
| 2-10 | Screw, Tapping | - | | 09182 | 0624-0077 | - |
| 2-11 | Machine Screw | - | | 09182 | 2200-0139 | - |
| 2-12 | Tube Clamp | 3 | | 09182 | 00230-20009 | 1 |
| 2-13 | Machine Screw | - | | 09182 | 2200-0145 | - |
| 2-14 | Clamp, Hose | 6 | QS700-M10H | 08484 | 1400-0720 | 2 |
| 2-15 | Terminal, Solder Lug | - | 2522-04-00 | 78189 | 0360-0374 | - |
| 2-16 | Hex Nut | - | | 09182 | 2260-0009 | - |
| 2-17 | Line Coupling | 3 | | 09182 | 00230-80001 | 1 |
| 2-18 | Turret Assembly (Z2) | 1 | | 09182 | 00230-60026 | 1 |
| 2-19 | NOT ASSIGNED | - | - | - | - | - |
| 2-20 | Set Screw | - | | 09182 | 3030-0033 | - |
| 2-21 through 2-25 | NOT ASSIGNED | - | - | - | - | - |
| 2-26 | Machine Screw | - | | 09182 | 2510-0107 | - |
| 2-27 | Lock Washer | - | 2-618-BC | 78452 | 2190-0008 | - |
| 2-28 | Screw, Tapping | - | | 09182 | 0624-0208 | - |
| 2-29 | NOT ASSIGNED | - | - | - | - | - |
| 2-30 | Lock Washer | - | 2-820-BC | 78452 | 2190-0010 | - |
| 2-31 | Detent Bracket | 1 | | 09182 | 00230-01010 | 1 |
| 2-32 | Machine Screw | - | | 09182 | 2510-0103 | - |
| 2-33 | Detent, Spring | 2 | | 09182 | 5000-3001 | 1 |
| 2-34 | Leaf, Spring | 1 | | 09182 | 1460-0209 | 1 |
| 2-35 | Machine Screw | - | | 09182 | 2360-0197 | - |
| 2-36 | Spacer, Internally Threaded Hex | 2 | 8583-A-0832 | 06540 | 00230-20038 | 1 |
| 2-37 | Set Screw | - | | 09182 | 3030-0001 | - |
| 2-38 | Roller Detent | 1 | | 09182 | 00230-20065 | 1 |
| 2-39 | Wheel Detent | 1 | | 09182 | 00230-20058 | 1 |
| 2-40 | Shaft, Amplifier Box | 1 | | 09182 | 00230-20016 | 1 |
| 2-41 | Retaining Ring | 1 | 5133-25-S-MD | 79136 | 0510-0083 | 1 |
| 2-42 | Bearing, Ball | 2 | 77R4LR3FY | 43334 | 1410-0231 | 1 |
| 2-43 | Washer, Flat | - | | 09182 | 3050-0273 | - |
| 2-44 | Bracket, Amplifier Box | 1 | | 09182 | 00230-01009 | 1 |
| 2-45 | Wiper, Rotor | 5 | | 09182 | 5000-4912 | |
| 2-46 | Line, Matching | 1 | | 09182 | 00230-00014 | 1 |
| 2-47 | Glass cloth insulation lgth as req'd | 1 | 27 | 76381 | 0460-0283 | 1 |
| 2-48 | Block & Contact Ass'y (see Fig. 6-8) | 3 | | 09182 | - | 1 |
| 2-49 | RF Connector | 1 | 8306-1 | 95712 | 1250-0794 | 1 |
| 2-50 | Machine Screw | - | | 09182 | 0520-0131 | - |
| 2-51 | NOT ASSIGNED | - | - | - | - | - |
| 2-52 | Waveguide Assembly | 2 | | 09182 | 00230-60016 | 1 |
| 2-53 | Bushing, Insulating | 1 | N5330-1 | 08863 | 1410-0232 | 1 |
| 2-54 | Grounding Strip | 3 | | 09182 | 00230-00053 | 1 |
| 2-55 | Machine Screw | - | | 09182 | 2200-0147 | - |
| 2-56 | Clip, Earless | 3 | 123.002 | 75915 | 1400-0175 | 1 |
| 2-57 | Plug, Terminal | 3 | | 09182 | 00230-20013 | 1 |
| 2-58 | Block & Contact Ass'y (see Fig. 6-6) | 3 | | 09182 | - | 1 |
| 2-59 | Terminal, Standoff | 2 | G-4777-10 | 12615 | 0340-0098 | 1 |

| ITEM NO. | DESCRIPTION | TQ | MFR. PART NO. | MFR. CODE | hp PART NO. | RS |
|---|---|---|---|---|---|---|
| 2-60 | Terminal, Solder Lug | - | 4029 | 77147 | 0360-0002 | - |
| 2-61 | Machine Screw | - | | 09182 | 2200-0147 | - |
| 2-62 | Lock Washer | - | | 09182 | 2190-0086 | - |
| 2-63 | NOT ASSIGNED | - | - | - | - | - |
| 2-64 | Lock Washer | - | | 09182 | 2190-0086 | - |
| 2-65 | Machine Screw 4-40 x 1/2 ph posi. | - | | 09182 | 0624-0026 | - |
| 2-66 | NOT ASSIGNED | - | - | - | - | - |
| 2-67 | Cover, RF Amplifier | 2 | | 09182 | 00230-20004 | - |
| 2-68 | Shield, Screen | 2 | | 09182 | 00230-00007 | 1 |
| 2-69 | Screw, Tapping | - | | 09182 | 0624-0208 | - |
| 2-70 | Machine Screw 8-32 x 3/8" ph posi. | - | | 09182 | 2510-0103 | - |
| 2-71 | Spacer, Shaft | 5 | | 09182 | 5020-2210 | 1 |
| 2-72 | Terminal, Standoff | 1 | X1581 | 71279 | 0340-0097 | 1 |
| 2-73 | Washer, Lock | - | 1902-00 | 78189 | 2190-0014 | - |


1
2
71
C20
3
45
67
69
68
70
5
7
V3
14
11
20
55
4
54
42
9
71
12
14
L27
56
57
L34
C14
17
5
20
8
48
13
4
15
16
9
45
C6
CR6
C13
7
18
48
71
53
13
4
7
14
V2
15
52
68
10
69
49
67
28

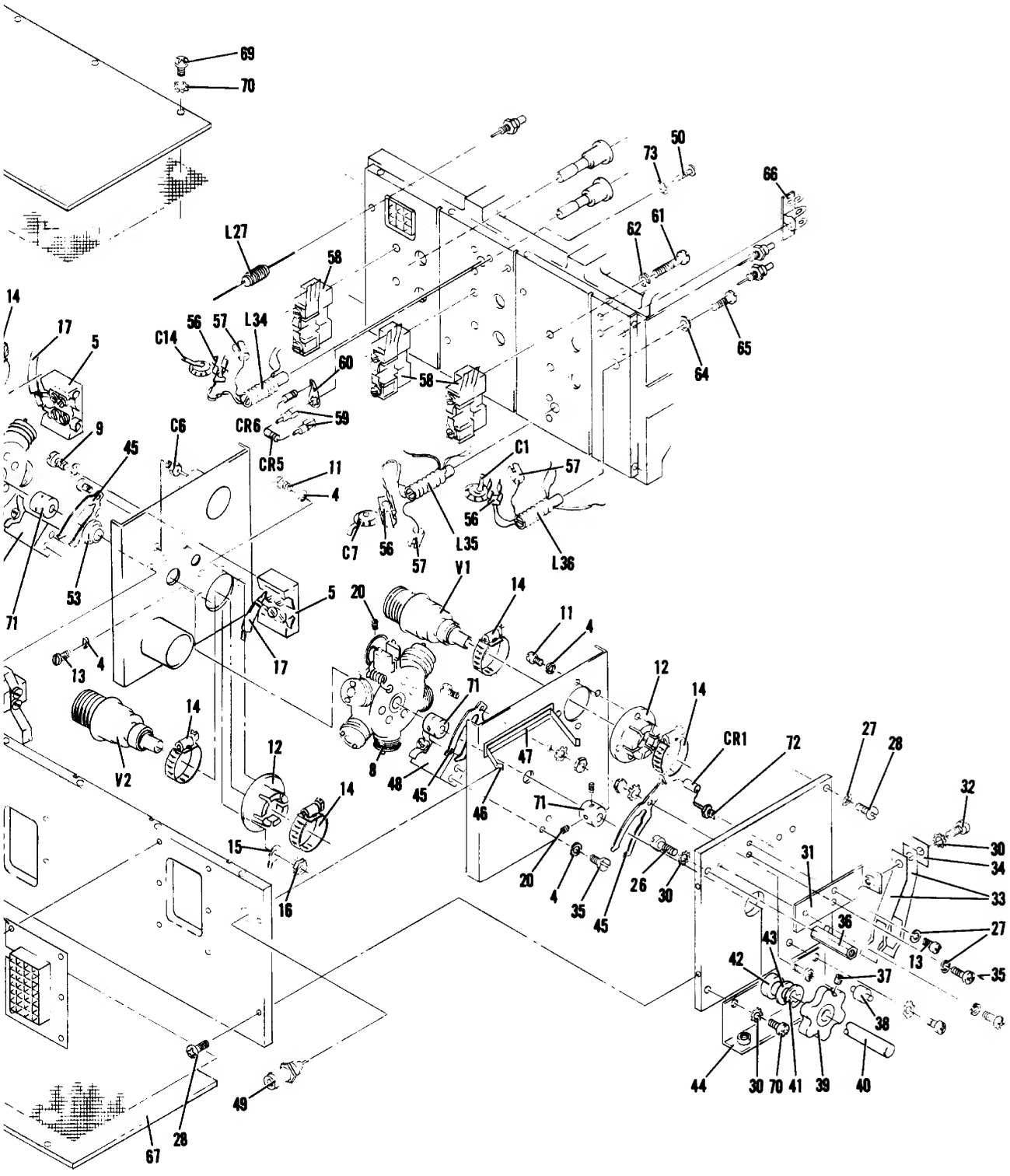
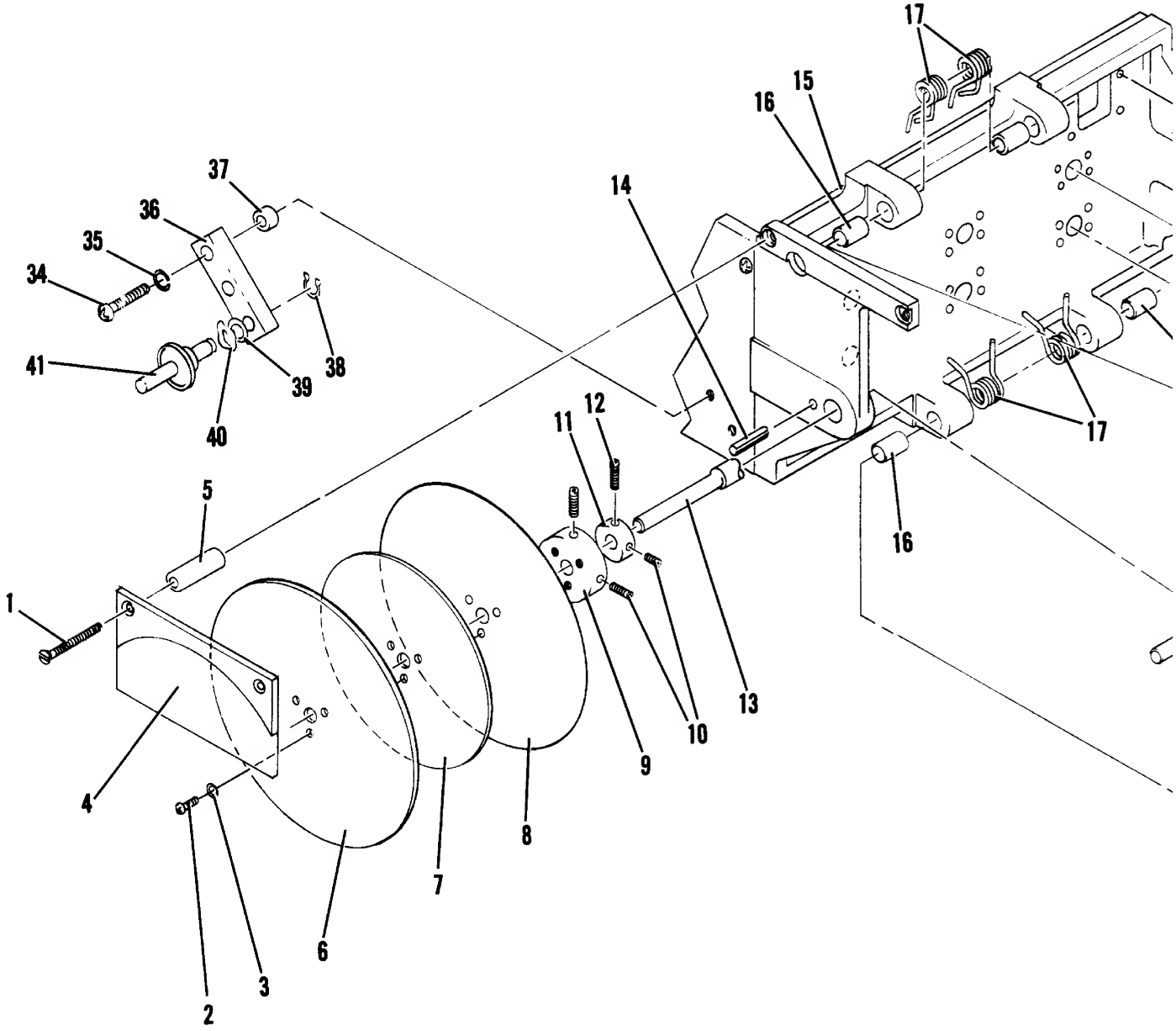



Figure 6-2. RF Amplifier Box Assembly

| ITEM NO. | DESCRIPTION | TQ | MFR. PART NO. | MFR. CODE | HP PART NO. | RS |
|---|---|---|---|---|---|---|
| | RF BOX MECHANICAL PARTS | | | | | |
| 3-1 | Machine Screw 1.5 in. lg. #4-40 thd | - | | 09182 | 2200-0176 | - |
| 3-2 | Machine Screw 0.5 in. lg. #4-40 thd | - | | 09182 | 2200-0147 | - |
| 3-3 | Lock Washer Helical Spring Type | - | | 09182 | 2190-0086 | - |
| 3-4 | Fiducial | 1 | | 09182 | 00230-20039 | 1 |
| 3-5 | Spacer | 2 | | 09182 | 00250-20115 | 1 |
| 3-6 | Dial | 1 | 1868-30-0010 | 83835 | 0350-0029 | 1 |
| 3-7 to 3-9 | Disc Drive Assembly | 1 | | 09182 | 00230-60012 | 1 |
| 3-7 | Spacer | 1 | | 09182 | 00230-00042 | 1 |
| 3-8 | Disc Drive | 1 | | 09182 | 00230-00041 | 1 |
| 3-9 | Hub | 1 | | 09182 | 00230-20018 | 1 |
| 3-10 | Set Screw .188 in. lg. #6-32 thd. | - | | 09182 | 3030-0033 | - |
| 3-11 | Collar | 1 | | 09182 | 00230-20050 | 1 |
| 3-12 | Set Screw .5 in. lg. #6-32 thd. | - | | 09182 | 3030-0143 | - |
| 3-13 | Cam Shaft | 1 | | 09182 | 00230-20082 | 1 |
| 3-14 | Rollpin .187 dia. 7/8 in. lg. | 1 | 79-040-187-0875 | 72962 | 1480-0149 | 1 |
| 3-15 | Pl. Side R. H. | 1 | | 09182 | 00230-21002 | 1 |
| 3-16 | Bearing, Sleeve | 4 | AA-307-3 | 70901 | 1410-0156 | 1 |
| 3-17 | Torsion Spring | 4 | | 09182 | 00230-80023 | 1 |
| 3-18 | Waveguide Assembly | 1 | | 09182 | 00230-60014 | 1 |
| 3-19 | Machine Screw .25 in. lg. #4-40 thd | - | | 09182 | 2200-0139 | - |
| 3-20 | Washer, Flat 7/8 OD .391 ID | - | | 09182 | 3050-0297 | - |
| 3-21 | Washer, Spring | - | | 09182 | 3050-0316 | - |
| 3-22 | Ring, Retaining | 1 | 5133-37-S-MD | 79136 | 0510-0235 | 1 |
| 3-23 | Bushing & Glass Assembly | 6 | | 09182 | 00230-60023 | 2 |
| 3-24 | Piston Ass'y. (see Paragraph 5-35) | 6 | | 09182 | - | 2 |
| 3-25 | Grounding Wiper Pl. | 6 | | 09182 | 00230-20068 | 2 |
| 3-26 | Plate Hinge | 1 | | 09182 | 00230-20043 | 1 |
| 3-27 | Shaft, Hinge Plate Pivot | 1 | | 09182 | 00230-20005 | 1 |
| 3-28 | Pin Hinge Plate Mounting | 3 | | 09182 | 00230-20069 | 1 |
| 3-29 | Spacer | 3 | | 09182 | 00230-20001 | 1 |
| 3-30 | Hex Nut 6-32 x $\frac{1}{4}$ x 3/32 in. | - | | 09182 | 2420-0007 | - |
| 3-31 | Bearing, Sleeve | 2 | AA-507-4 | 70901 | 1410-0157 | 1 |
| 3-32 | Cam RF Translator | 2 | | 09182 | 00230-40001 | 1 |
| 3-33 | Set Screw #6-32 thd. .188 in. lg. | - | | 09182 | 3030-0033 | - |
| 3-34 | Machine Screw #8-32 thd. .875 lg. | - | | 09182 | 2510-0015 | - |
| 3-35 | Lock Washer Helical Spring Type | - | | 09182 | 2190-0087 | - |
| 3-36 | Plate Support | 1 | | 09182 | 00230-00006 | 1 |
| 3-37 | Spacer, Sleeve | 1 | | 09182 | 00230-20003 | 1 |
| 3-38 | Retaining Ring | 1 | 5100-25-S-MD | 79136 | 0510-0005 | 1 |
| 3-39 | Flat Washer | - | | 09182 | 3050-0017 | - |
| 3-40 | Washer, Spring | - | | 09182 | 3050-0272 | - |
| 3-41 | Vernier Drive Assembly | 1 | | 09182 | 00230-60013 | 1 |
| 3-42 | Terminal, Solder Lug | - | 2102-04-00 | 78189 | 0360-0371 | - |
| 3-43 | Terminal Board | 1 | 1520-A | 71785 | 0360-0364 | 1 |
| 3-44 | Clamp, Plastic | 3 | HP-4N | 09922 | 1400-0126 | 1 |


17
15
16
37
36
35
34
14
41
39
38
40
12
11
5
1
16
17
13
10
9
4
8
7
6
3
2

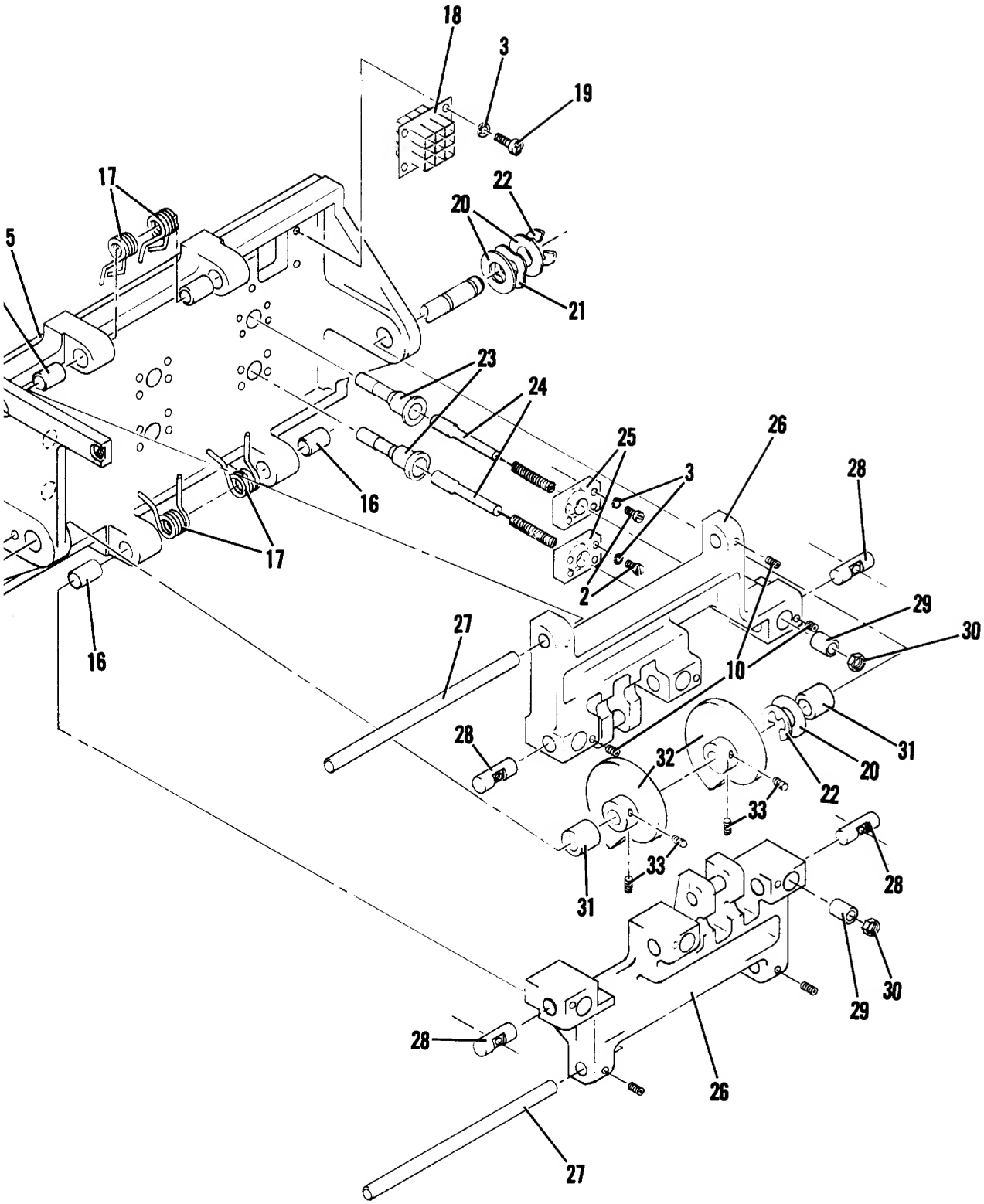



Figure 6-3. Hinge Plate Assembly

| ITEM NO. | DESCRIPTION | TQ | MFR. PART NO. | MFR. CODE | HP PART NO. | RS |
|---|---|---|---|---|---|---|
| | CONTACT BLOCK PARTS | | | | | |
| 4-1 | NOT ASSIGNED | - | - | - | - | - |
| 4-2 | Lock Washer | - | | 09182 | 2190-0086 | - |
| 4-3 | Block, Contact | 3 | | 09182 | 00230-20010 | 1 |
| 4-4 | Contact, Turret | 3 | | 09182 | 00230-60043 | 1 |
| 4-5 | Machine Screw | - | | 09182 | 2200-0137 | - |
| 5-1 | Block, Contact | 3 | | 09182 | 00230-20011 | 1 |
| 5-2 | Plug, Terminal | 3 | | 09182 | 00230-20013 | 1 |
| 5-3 | Contact Spring | 3 | | 09182 | 00230-00035 | 1 |
| 5-4 | Machine Screw 4-40 x $\frac{1}{4}$ Binder Hd. | - | | 09182 | - | - |
| 5-5 | Contact, Spring | 3 | | 09182 | 00230-00036 | 1 |
| 6-1 | Grounding Strip | 3 | | 09182 | 00230-00053 | 1 |
| 6-2 | Block, Contact | 3 | | 09182 | 00230-20012 | 1 |
| 6-3 | Contact, Spring | 3 | | 09182 | 00230-00037 | 1 |
| 6-4 | Terminal, Solder Lug | - | 902-016-C | 78584 | 0360-0037 | - |
| 6-5 | Washer, Lock | - | | 09182 | 2190-0086 | - |
| 6-6 | Machine Screw 4-40 x $\frac{1}{4}$ Pan head | - | | 09182 | 2200-0139 | - |
| 7-1 | Block, Shorting Contact | 3 | | 09182 | 00230-20014 | 1 |
| 7-2 | NOT ASSIGNED | - | - | - | - | - |
| 7-3 | Washer, Lock | - | | 09182 | 2190-0086 | - |
| 7-4 | Contact, Shorting | 3 | | 09182 | 00230-00038 | 1 |
| 7-5 | Screw, Machine 4-40 x $\frac{1}{4}$ Binder hd. | - | | 09182 | - | - |

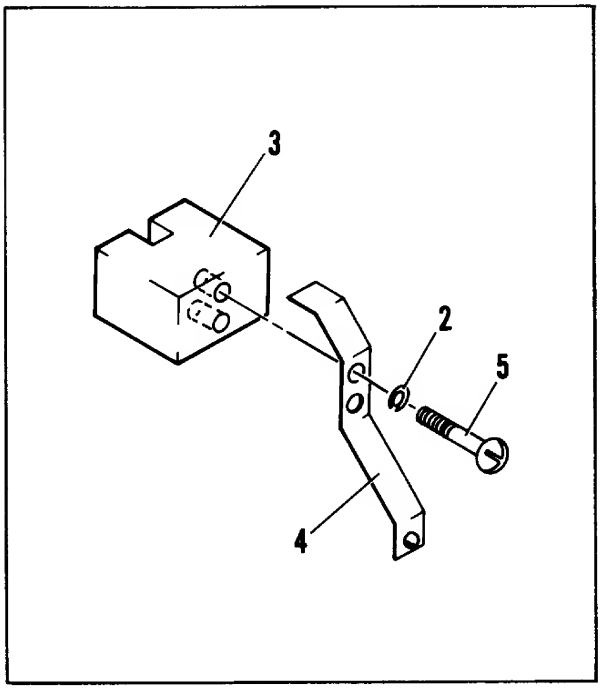



Figure 6-4. Refer to Figure 6-2, #7

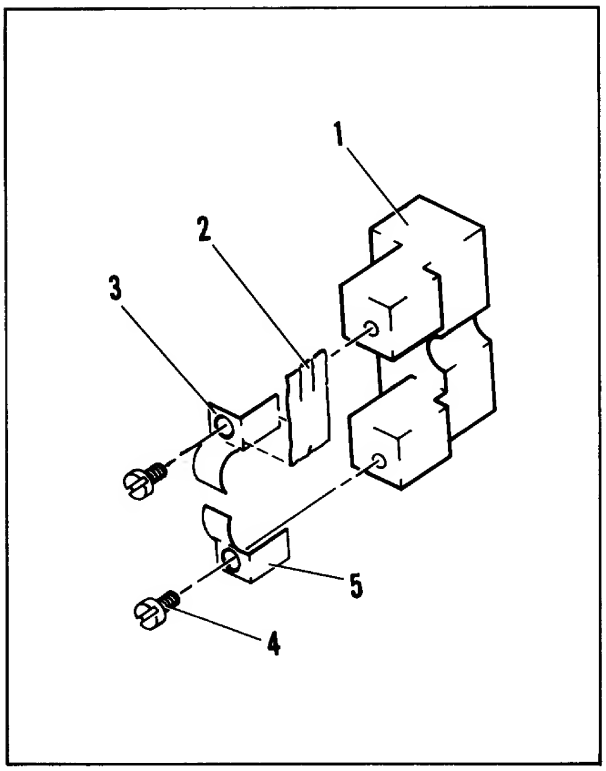



Figure 6-5. Refer to Figure 6-2, #58

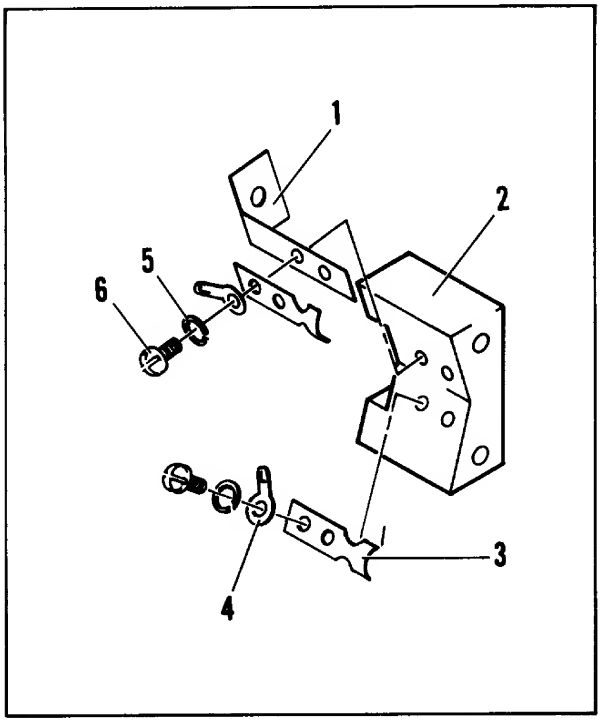



Figure 6-6. Refer to Figure 6-2, #5

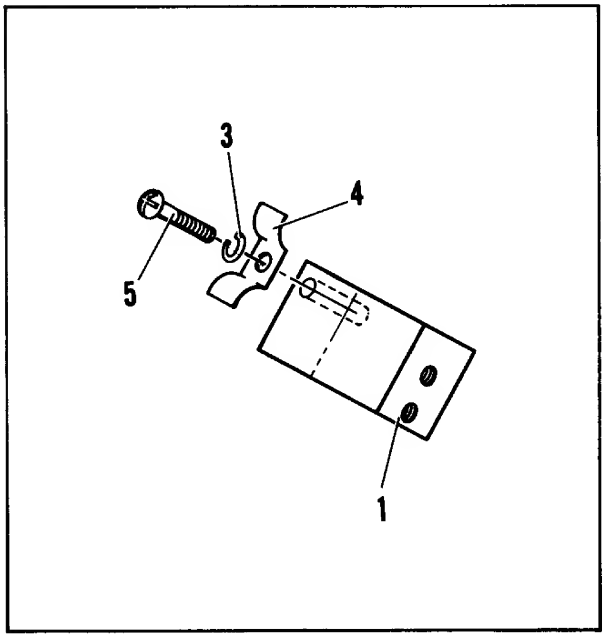



Figure 6-7. Refer to Figure 6-2, #48

# SECTION VII
# CIRCUIT DIAGRAMS

This section contains the circuit diagrams necessary for the operation and maintenance of this unit. Included are:

a. Component Location Diagrams which shows the physical location and reference designator of parts mounted on the printed wiring board.

b. Schematic Diagram, which illustrates the circuitry for the entire unit. Voltages are given adjacent to test points, identified by encircled numbers on the schematic.

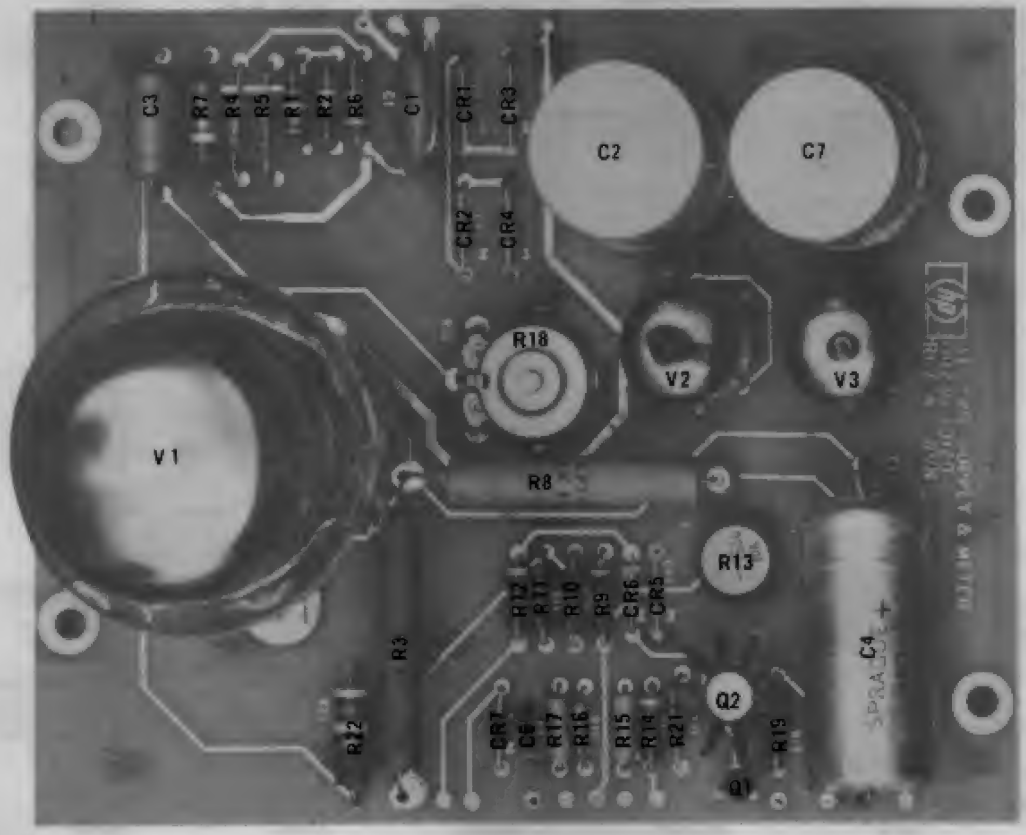
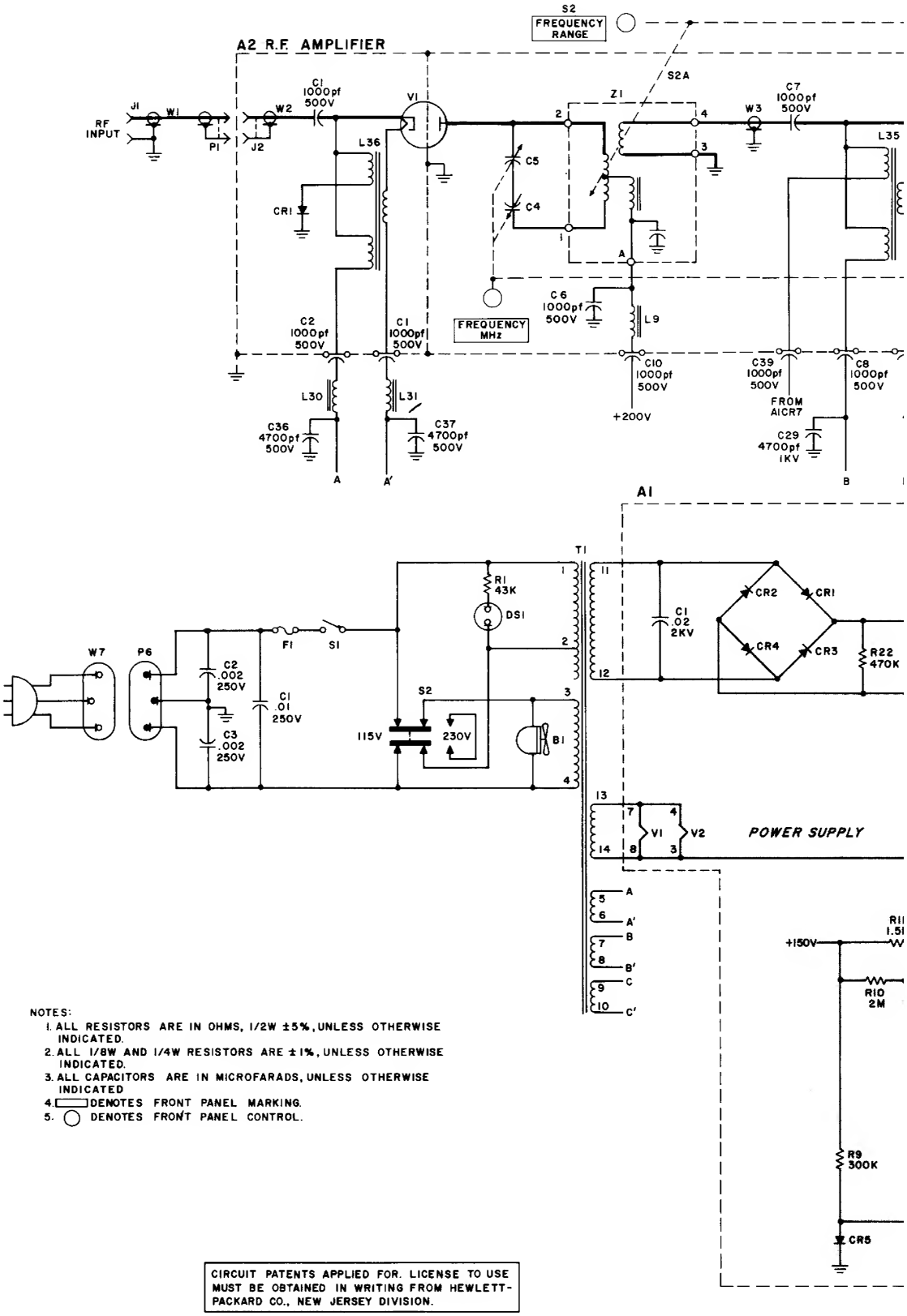



Figure 7-1. A1, Main Printed Circuit Board, Component Location




NOTES:

1. ALL RESISTORS ARE IN OHMS, 1/2W ±5%, UNLESS OTHERWISE INDICATED.
2. ALL 1/8W AND 1/4W RESISTORS ARE ±1%, UNLESS OTHERWISE INDICATED.
3. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE INDICATED
4. ▭ DENOTES FRONT PANEL MARKING.
5. ◯ DENOTES FRONT PANEL CONTROL.

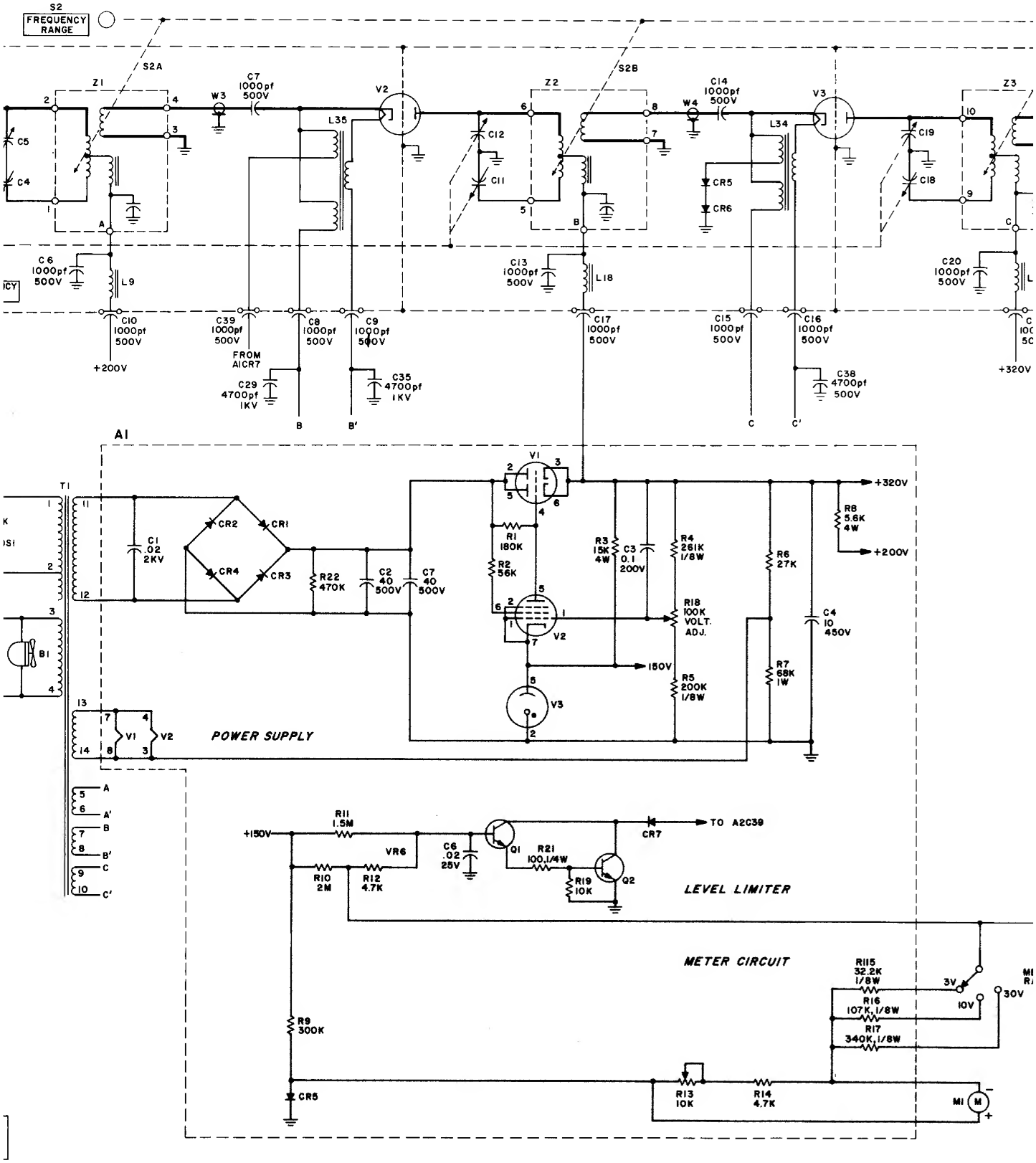



Figure 7-2. Mode

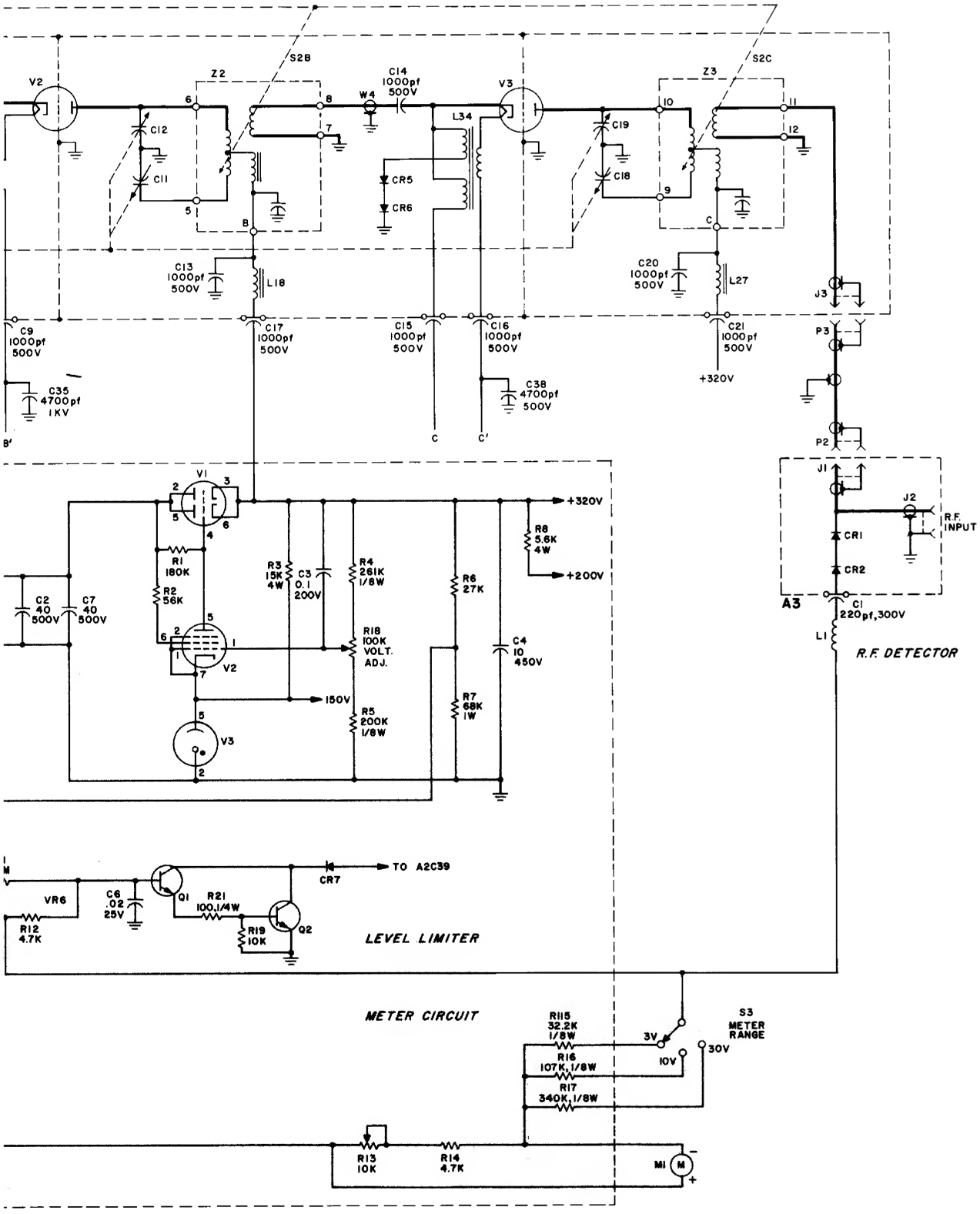



Figure 7-2. Model 230B, Schematic Diagram

# MANUAL CHANGES

MODEL: 230B

Manual Serial Prefixed: 935

HP Part No.: 00230-90039

To adapt this manual to instruments with other serial previxes check for errata below, and make changes shown in tables.

| Instrument Serial Prefix | Make Manual Changes |
|---|---|
| Errata | All |
| 936 | 1 |
| 1026 | 1,2 |
| 1202 | 1,2,3 |

| Instrument Serial Prefix | Make Manual Changes |
|---|---|
| | |
| | |
| | |
| | |

Δ New or revised item.

ERRATA

Page 4-2, Paragraph 4-11.

The fourth sentence in the paragraph should read: This is accomplished by making the piston of A2C12 (A2C4 and A2C18) physically shorter than A2C11(A2C5 and A2C19).

Page 4-2, Paragraph 4-17.

The first sentence should read: The cathode of A1V1 supplies a regulated +320 volts to RF amplifiers A2V2 and A2V3. Resistor R8 drops the +320 volts to +200 volts for RF amplifier A2V1.

Page 5-7, Paragraph 5-42 (step g.)

Change: R125 to R13

Page 7-1, Figure 7-2.

Change notation of RF Input adjacent to A3-J2 to read RF Output.

Figures 5-1, 5-2, and 5-4.

Delete: HP Part No. 8491A for the 10db attenuator. Use instead HP Part No. 0950-0094 10db attenuator. Also reverse the physical positions of the attenuators so that the 10db attenuator is closest to the 50 ohm termination.

25 JAN 1972

CHANGE 1

Page 6-6. Table 6-4.

Change: DS1 description to read: light indicator (white) part number to 1450-0419.

F1(115v) part number to 2110-0303

F1 (230v) part number to 2110-0312

S1 part number to 3101-0003

S2 part number to 3101-1234

A1R15 description to read: 31.6K part number to 0698-3160.

Page 6-12, Item 5-2.

Change: description to read Strap, part number to 00230-00013.

Page 7-1, Figure 7-2. Schematic Diagram (meter circuit).

Change: R115 to read R15 and description to 31.6Kohms.

Δ CHANGE 2.

Page 6-5, Table 6-4.

Change the part number for Frequency Knob to 0370-0038.
Change the part number for Meter Bezel to 4040-0293.

Δ CHANGE 3.

The standard colors for this instrument are now mint gray (for front panel) and olive gray (for all other external surfaces). Option X95 designates use of the former color scheme of light gray and blue gray. Option A85 designates use of a light gray front panel with olive gray used for all other external surfaces. New part numbers are shown below:

| DESCRIPTION | HP Part Number | | |
|---|---|---|---|
| | Standard | Option A85 | Option X95 |
| Front Panel | 00230-01017 | 00230-01004 | Refer to Manual Parts List |
| Cabinet Assembly | 00230-61007 | 00230-61007 | |
| Air Filter | 5060-8772 | 5060-8772 | |

# HEWLETT • PACKARD hp SALES AND SERVICE

## EUROPE

**AUSTRIA**
Unilabor GmbH
Wissenschaftliche Instrumente
Rummelhardtgasse 6
P.O. Box 33
**Vienna** A-1095
Tel: (222) 42 61 81, 43 13 94
**Cable: LABORINSTRUMENT Vienna**
**Telex: 75 762**

**BELGIUM**
Hewlett-Packard S.A. Benelux
348 Boulevard du Souverain
**Brussels** 1160
Tel: 72 22 40
Cable: PALOBEN Brussels
Telex: 23 494

**DENMARK**
Hewlett-Packard A/S
Datavej 38
DK-3460 **Birkerod**
Tel: (01) 81 66 40
Cable: HEWPACK AS
Telex: 66 40

Hewlett-Packard A/S
Torvet 9
DK-8600 **Silkeborg**
Tel: (06) 827-840

**FINLAND**
Hewlett-Packard Oy
Bulevardi 26
P.O. Box 12185
**Helsinki** 12
Tel: 13-730
**Cable: HEWPACKOY-Helsinki**
Telex: 12-1563

**FRANCE**
Hewlett-Packard France
Quartier de Courtaboeuf
**Boîte Postale No. 6**
91 Orsay
Tel: 1-920 88 01
Cable: HEWPACK Orsay
**Telex: 60048**

Hewlett-Packard France
4 Quai des Etroits
69 **Lyon** 5ème
Tel: 78-42 63 45
Cable: HEWPACK Lyon
Telex: 31617

Hewlett-Packard France
29 rue de la Gara
F-31 **Blagnac**
Tel. (61) 85 82 29
Telex: 51957

**GERMANY**
Telex: 41 32 49 FRA
Berliner Strasse 117
**6 Nieder-Eschbach/Frankfurt 56**
Tel: (0611) 50 10 64
Cable: HEWPACKSA Frankfurt
Hewlett-Packard Vertriebs-GmbH

Hewlett-Packard Vertriebs-GmbH
Lietzenburgerstrasse 30
1 **Berlin** 30
Tel: (0311) 211 60 16
Telex: 18 34 05

Hewlett-Packard Vertriebs-GmbH
Herrenbergerstrasse 110
**703 Böblingen**, Württemberg
Tel: 07031-6671
Cable: HEPAG Böblingen
Telex: 72 65 739

Hewlett-Packard Vertriebs-GmbH
Achenbachstrasse 15
4 **Düsseldorf** 1
Tel: (0211) 68 52 58/59
Telex: 85 86 533

Hewlett-Packard Vertriebs-GmbH
Wendenstr. 23
2 **Hamburg** 1
Tel: (0411) 24 05 51/52
Cable: HEWPACKSA Hamburg
Telex: 21 53 32

Hewlett-Packard Vertriebs-GmbH
Reginfriedstrasse 13
8 **München** 9
Tel: (0811) 69 59 71/75
Cable: HEWPACKSA München
Telex: 52 49 85

**GREECE**
Kostas Karayannis
18, Ermou Street
**Athens** 126
Tel: 230301,3,5
Cable: RAKAR Athens
Telex: 21 59 62 RKAR GR

**IRELAND**
Hewlett-Packard Ltd.
224 Bath Road
**Slough**, Bucks, England
Tel: Slough 753-33341
Cable: HEWPIE Slough
Telex: 84413

**ITALY**
Hewlett-Packard Italiana S.p.A.
Via Amerigo Vespucci 2
20124 **Milano**
Tel: (2) 6251 (10 lines)
Cable: HEWPACKIT Milan
Telex: 32046

Hewlett-Packard Italiana S.p.A.
Palazzo Italia
Piazza Marconi 25
00144 **Rome** - Eur
Tel: 6-591 2544
Cable: HEWPACKIT Rome
Telex: 61514

**NETHERLANDS**
Hewlett-Packard Benelux, N.V.
Weerdestein 117
P.O. Box 7825
**Amsterdam, Z** 11
Tel: 020-42 7777
Cable: PALOBEN Amsterdam
Telex: 13 216

**NORWAY**
Hewlett-Packard Norge A/S
Box 149
Nesveien 13
N-1344 **Haslum**
Tel: 2-53 83 60
Cable: HEWPACK Oslo
Telex: 16621

**PORTUGAL**
Telectra
Empresa Tecnica de Equipamentos
Electricos, S.a.r.l.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
**Lisbon** 1
Tel: 68 60 72
Cable: TELECTRA Lisbon
Telex: 1598

**SPAIN**
Enrique Larreta 12
**Madrid**, 16
Tel: 215 35 43
Cable: TELEATAIO Madrid
Ataio Ingenieros SA
Telex: 27249E

Ataio Ingenieros SA
Ganduxer 76
**Barcelona** 6
Tel: 211-44-66
Cable: TELEATAIO BARCELONA

**SWEDEN (Jan 71)**
Hewlett-Packard Sverige AB
Enighetsvägen 1-3
Fack
**S-16120 Bromma 20**
Tel: (08) 98 12 50
**Cable: MEASUREMENTS Stockholm**
Telex: 10721

**Hewlett-Packard Sverige AB**
**Hagakersgatan 9C**
**S 431 04 Mölndal** 4
**Tel: 031 - 27 68 00**

**SWITZERLAND**
**Hewlett Packard Schweiz AG**
**Zurcherstrasse 20**
**8952 Schlieren**
**Zurich**
Tel: (051) 98 18 21/24
Cable: HPAG CH
Telex: 53933

**Hewlett Packard Schweiz A.G.**
**Rue du Bois-du-Lan 7**
**1217 Meyrin 2 Geneva**
Tel: (022) 41 54 00
Cable: HEWPACKSA Geneva
Telex: 2 24 86

**TURKEY**
**Telekom Engineering Bureau**
P.O. Box 376
Karakoy
**Istanbul**
**Tel: 49 40 40**
**Cable: TELEMATION Istanbul**

**UNITED KINGDOM**
Hewlett-Packard Ltd.
224 Bath Road
**Slough**, Bucks
Tel: Slough (0753) 33341
Cable: HEWPIE Slough
Telex: 84413

Hewlett-Packard Ltd.
The Graftons
Stamford New Road
**Altrincham**, Cheshire
Tel: 061 928-8626
Telex: 668068

**YUGOSLAVIA**
**Belram S.A.**
**83 avenue des Mimosas**
**Brussels** 1150, Belgium
Tel: 34 33 32, 34 26 19
**Cable: BELRAMEL Brussels**
Telex: 21790

**SOCIALIST COUNTRIES PLEASE CONTACT:**
Correspondence Office for Eastern Europe
Innstrasse 23/2
Postfach
A1204 **Vienna**, Austria
Tel: (222) 3366 06/09
Cable: HEWPACK Vienna
Telex: 75923

**ALL OTHER EUROPEAN COUNTRIES CONTACT:**
**Hewlett-Packard S.A.**
**Rue du Bois-du-Lan 7**
1217 **Meyrin 2 Geneva**
Switzerland
Tel: (022) 41 54 00
Cable: HEWPACKSA Geneva
Telex: 2.24.86

## AFRICA, ASIA, AUSTRALIA

**ANGOLA**
Telectra Empresa Técnia de Equipamentos Eléctricos SAR
Rua de Barbosa Rodrigues 42-1°
Box 6487
**Luanda**
Cable: TELECTRA Luanda

**AUSTRALIA**
Hewlett-Packard Australia Pty. Ltd.
22-26 Weir Street
**Glen Iris**, 3146
Victoria
Tel: 20.1371 (6 lines)
**Cable: HEWPARD Melbourne**
Telex: 31024

Hewlett-Packard Australia Pty. Ltd.
61 Alexander Street
**Crows Nest** 2065
New South Wales
Tel: 43.7866
Cable: HEWPARD Sydney
Telex: 21561

Hewlett-Packard Australia Pty. Ltd.
97 Churchill Road
**Prospect** 5082
South Australia
Tel: 65.2366
Cable: HEWPARD Adelaide

**Hewlett Packard Australia** Pty. Ltd.
2nd Floor, Suite 13
Casablanca Buildings
196 Adelaide Terrace
**Perth**, W.A. 6000
Tel: 21-3330
Cable: HEWPARD Perth

Hewlett-Packard Australia Pty. Ltd.
10 Woolley Street
P.O. Box 191
**Dickson A.C.T.** 2602
Tel: 49-8194
Cable: HEWPARD Canberra ACT

**CEYLON**
United Electricals Ltd.
**P.O. Box 681**
Yahala Building
Staples Street
**Colombo** 2
**Tel: 5496**
**Cable: HOTPOINT Colombo**

**CYPRUS**
Kypronics
19 Gregorios & Xenopoulos Road
P.O. Box 1152
**Nicosia**
**Tel:** 6282-75628
**Cable: HE-I-NAMI**

**ETHIOPIA**
African Salespower & Agency Private Ltd., Co.
P. O. Box 718
58/59 Cunningham St.
**Addis Ababa**
Tel: 12285
**Cable:** ASACO Addisababa

**HONG KONG**
Schmidt & Co. (Hong Kong) Ltd.
P.O. Box 297
1511, Prince's Building 15th Floor
10, Chater Road
**Hong Kong**
Tel: 240168, 232735
Cable: SCHMIDTCO Hong Kong

**INDIA**
Blue Star Ltd.
Kasturl Buildings
Jamshedji Tata Rd.
**Bombay** 20BR, India
Tel: 29 50 21
Telex: 2396
Cable: BLUEFROST

Blue Star Ltd.
Band Box House
Prabhadevi
**Bombay** 25DD, India
Tel: 45 73 01
Telex: 2396
Cable: BLUESTAR

Blue Star Ltd.
14/40 Civil Lines
**Kanpur**, India
Tel: 6 88 82
Cable: BLUESTAR

Blue Star, Ltd.
7 Hare Street
P.O. Box 506
**Calcutta** 1, India
Tel: 23-0131
Telex: 655
Cable: BLUESTAR

Blue Star Ltd.
Blue Star House,
34 Ring Road
Lajpat Nagar
**New Delhi** 24, India
Tel: 62 32 76
Telex: 463
Cable: BLUESTAR

Blue Star Ltd.
17-C Ulsoor Road
Bangalore-8

Blue Star, Ltd.
96 Park Lane
**Secunderabad** 3, India
Tel: 7 63 91
Cable: BLUEFROST

Blue Star, Ltd.
23/24 Second Line Beach
**Madras** 1, India
Tel: 2 39 55
Telex: 379
Cable: BLUESTAR

Blue Star, Ltd.
1B Kaiser Bungalow
Dindli Road
**Jamshedpur**, India
Tel: 38 04
Cable: BLUESTAR

**INDONESIA**
Bah Bolon Trading Coy. N.V.
Djalah Merdeka 29
**Bandung**
Tel: 4915 51560
Cable: ILMU
Telex: 809

**IRAN**
Telecom, Ltd.
P. O. Box 1812
240 Kh. Saba Shomali
**Teheran**
Tel: 43850, 48111
Cable: BASCOM Teheran

**ISRAEL**
Electronics & Engineering Div. of Motorola Israel Ltd.
17 Aminadav Street
**Tel-Aviv**
Tel: 36941 (3 lines)
Cable: BASTEL Tel-Aviv
Telex: Bastel Tv 033-569

**JAPAN**
Yokogawa-Hewlett-Packard Ltd.
Ohashi Building
59 Yoyogi 1-chrome
**Shibuya-ku, Tokyo**
Tel: 03-370-2281/7
Telex: 232-2024YHP
Cable: YHPMARKET TOK 23-724

Yokogawa-Hewlett-Packard Ltd.
Nisei Ibaragi Bldg.
2-2-8 Kasuga
Ibaragi-Shi
**Osaka**
Tel: 23-1641

Yokogawa-Hewlett-Packard Ltd.
Ito Building
No. 59, Kotori-cho
**Nakamura-ku, Nagoya** City
Tel: 551-0215

Yokogawa-Hewlett-Packard Ltd.
Nitto Bldg.
2300 Shinohara-cho,
Kohoku-ku
**Yokohama** 222
Tel: (405) 432-1504/5

**KENYA**
R. J. Tilbury Ltd.
P. O. Box 2754
**Suite 517/518**
Hotel Ambassadeur
**Nairobi**
Tel: 25670, 68206, 58196
Cable: ARJAYTEE Nairobi

**LEBANON**
Constantin E. Macridis
Clemenceau Street
P.O. Box 7213
**Beirut**
Tel: 220846
Cable: ELECTRONUCLEAR Beirut

**MALAYSIA**
MECOMB Malaysia Ltd.
2 Lorong 13/6A
Section 13
Petaling Jaya, **Selangor**
Cable: MECOMB Kuala Lumpur

**MOZAMBIQUE**
A. N. Goncalves, LDA.
4.1 Apt. 14 Av. D. Luis
P.O. Box 107
**Lourenco Marques**
Cable: NEGON

**NEW ZEALAND**
Hewlett-Packard (N.Z.) Ltd.
32-34 Kent Terrace
P.O. Box 9443
**Wellington, N.Z.**
Tel: 56-559
Cable: HEWPACK Wellington

Hewlett Packard (N.Z.) Ltd.
Box 51092
**Pukuranga**
Tel: 573-733

**PAKISTAN (EAST)**
**Mushko & Company, Ltd.**
Zirat Chambers
31, Jinnah Avenue
**Dacca**
Tel: 280058
Cable: NEWDEAL Dacca

**PAKISTAN (WEST)**
**Mushko & Company, Ltd.**
Oosman Chambers
Victoria Road
**Karachi** 3
Tel: 511027, 512927
Cable: COOPERATOR Karachi

**PHILIPPINES**
Electromex Inc.
Makati Commercial Center
2129 Pasong Tamo
Makati, Rizal D 708
P.O. Box 1028
**Manila**
Tel: 89-85-01
Cable: ELEMEX Manila

**SINGAPORE**
Mechanical and Combustion Engineering Company Ltd.
9, Jalan Kilang
Red Hill Industrial Estate
**Singapore, 3**
Tel: 642361-3
Cable: MECOMB Singapore

**SOUTH AFRICA**
Hewlett Packard South Africa (Pty.), Ltd.
P.O. Box 31716
Braamfontein Transvaal
Milnerton
30 De Beer Street
**Johannesburg**
Tel: 725-2080, 725-2030
**Telex: 0226 JH**
**Cable: HEWPACK Johannesburg**

Hewlett Packard South Africa (Pty.), Ltd.
Breecastle House
Bree Street
**Cape Town**
Tel: 3-6019, 3-6545
Cable: HEWPACK Cape Town
Telex: 5-0006

Hewlett Packard South Africa (Pty.), Ltd.
308 Glenwood Centre
Corner Hunt & Moore Roads
P.O. Box 99
**Overport**, Natal
Tel: 347536

**TAIWAN REP. OF CHINA**
Hewlett Packard Taiwan
39 Chung Shiao West
Sec. 1
**Overseas Insurance Corp. Bldg. 7th Floor**
**Taipei**
Tel: 579-605, 579-610, 579-613
Telex: c/o Bankamerica TP 339
Cable: HEWPACK Taipei

**THAILAND**
**The International Engineering Co., Ltd.**
P. O. Box 39
**614 Sukhumvit Road**
**Bangkok**
**Tel: 910722** (7 lines)
Cable: GYSOM
**TLX INTENCO BK-226 Bangkok**

**VIETNAM**
**Peninsular Trading Inc.**
**P.O. Box H-3**
**216 Hien-Vuong**
**Saigon**
**Tel: 20.805**
**Cable: PENINSULA Saigon**

**ZAMBIA**
R. J. Tilbury (Zambia) Ltd.
P.O. Box 2792
**Lusaka**
Zambia, Central Africa

**MEDITERRANEAN AND MIDDLE EAST COUNTRIES NOT SHOWN PLEASE CONTACT:**
Hewlett-Packard Correspondence Office
Piazza Marconi 25
I-00144 Rome-Eur, Italy
Tel: (6) 59 40 29
Cable: HEWPACKIT Rome
Telex: 61514

**OTHER AREAS NOT LISTED, CONTACT:**
**Hewlett-Packard INTERCONTINENTAL**
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 326-7000
(Feb. 71 493-1501)
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8461

# HEWLETT • PACKARD SALES AND SERVICE

## SALES & SERVICE OFFICES

## UNITED STATES

**ALABAMA**
P.O. Box 4207
2003 Byrd Spring Road S.W.
**Huntsville** 35802
**Tel:** (205) 881-4591
**TWX:** 810-726-2204

**ARIZONA**
2336 E. Magnolia St.
**Phoenix** 85034
Tel: (602) 252-5061
TWX: 910-951-1330

5737 East Broadway
**Tucson** 85716
Tel: (602) 298-2313
TWX: 910-952-1162

**CALIFORNIA**
1430 East Orangethorpe Ave.
**Fullerton** 92631
Tel: (714) 870-1000

3939 Lankershim Boulevard
**North Hollywood** 91604
Tel: (213) 877-1282
TWX: 910-499-2170

1101 Embarcadero Road
**Palo Alto** 94303
Tel: (415) 327-6500
TWX: 910-373-1280

2220 Watt Ave.
**Sacramento** 95825
Tel: (916) 482-1463
TWX: 910-367-2092

9606 Aero Drive
**San Diego** 92123
Tel: (714) 279-3200
TWX: 910-335-2000

**COLORADO**
7965 East Prentice
**Englewood** 80110
Tel: (303) 771-3455
TWX: 910-935-0705

**CONNECTICUT**
508 Tolland Street
**East Hartford** 06108
Tel: (203) 289-9394
TWX: 710-425-3416

111 East Avenue
**Norwalk** 06851
Tel: (203) 853-1251
TWX: 710-468-3750

**FLORIDA**
P.O. Box 24210
2806 W. Oakland Park Blvd.
**Ft. Lauderdale** 33307
Tel: (305) 731-2020
TWX: 510-955-4099

P.O. Box 20007
Herndon Station 32814
621 Commonwealth Avenue
**Orlando**
Tel: (305) 841-3970
TWX: 810-850-0113

**GEORGIA**
P.O. Box 28234
450 Interstate North
**Atlanta** 30328
Tel: (404) 436-6181
TWX: 810-766-4890

**ILLINOIS**
5500 Howard Street
**Skokie** 60076
Tel: (312) 677-0400
TWX: 910-223-3613

**INDIANA**
3839 Meadows Drive
**Indianapolis** 46205
Tel: (317) 546-4891
TWX: 810-341-3263

**LOUISIANA**
P.O. Box 856
1942 Williams Boulevard
**Kenner** 70062
Tel: (504) 721-6201
TWX: 810-955-5524

**MARYLAND**
6707 Whitestone Road
**Baltimore** 21207
Tel: (301) 944-5400
TWX: 710-862-0850

P.O. Box 1648
2 Choke Cherry Road
**Rockville** 20850
Tel: (301) 948-6370
TWX: 710-828-9684

**MASSACHUSETTS**
32 Hartwell Ave.
**Lexington** 02173
Tel: (617) 861-8960
TWX: 710-326-6904

**MICHIGAN**
24315 Northwestern Highway
**Southfield** 48075
Tel: (313) 353-9100
TWX: 810-224-4882

**MINNESOTA**
2459 University Avenue
**St. Paul** 55114
Tel: (612) 645-9461
TWX: 910-563-3734

**MISSOURI**
11131 Colorado Ave.
**Kansas City** 64137
Tel: (816) 763-8000
TWX: 910-771-2087

2812 South Brentwood Blvd.
**St. Louis** 63144
Tel: (314) 962-5000
TWX: 910-760-1670

**NEW JERSEY**
W. 120 Century Road
**Paramus** 07652
Tel: (201) 265-5000
TWX: 710-990-4951

1060 N. Kings Highway
**Cherry Hill** 08034
Tel: (609) 667-4000
TWX: 710-892-4945

**NEW MEXICO**
P.O. Box 8366
Station C
6501 Lomas Boulevard N.E.
**Albuquerque** 87108
Tel: (505) 265-3713
TWX: 910-989-1665

156 Wyatt Drive
**Las Cruces** 88001
Tel: (505) 526-2485
TWX: 910-983-0550

**NEW YORK**
1702 Central Avenue
**Albany** 12205
Tel: (518) 869-8462
TWX: 710-441-8270

1219 Campville Road
**Endicott** 13760
Tel: (607) 754-0050
TWX: 510-252-0890

82 Washington Street
**Poughkeepsie** 12601
Tel: (914) 454-7330
TWX: 510-248-0012

39 Saginaw Drive
**Rochester** 14623
Tel: (716) 473-9500
TWX: 510-253-5981

1025 Northern Boulevard
**Roslyn, Long Island** 11576
Tel: (516) 869-8400
TWX: 510-223-0811

5858 East Molloy Road
**Syracuse** 13211
Tel: (315) 454-2486
TWX: 710-541-0482

**NORTH CAROLINA**
P.O. Box 5188
1923 North Main Street
**High Point** 27262
**Tel: (919) 885-8101**
**TWX: 510-926-1516**

**OHIO**
25575 Center Ridge Road
**Cleveland** 44145
**Tel:** (216) 835-0300
TWX: 810-427-9129

3460 South Dixie Drive
**Dayton** 45439
Tel: (513) 298-0351
TWX: 810-459-1925

1120 Morse Road
**Columbus** 43229
Tel: (614) 846-1300

**OKLAHOMA**
2919 United Founders Boulevard
**Oklahoma City** 73112
Tel: (405) 848-2801
TWX: 910-830-6862

**OREGON**
Westhills Mall, Suite 158
4475 S.W. Scholls Ferry Road
**Portland** 97225
Tel: (503) 292-9171
TWX: 910-464-6103

**PENNSYLVANIA**
2500 Moss Side Boulevard
**Monroeville** 15146
Tel: (412) 271-0724
TWX: 710-797-3650

1021 8th Avenue
King of Prussia Industrial Park
**King of Prussia** 19406
Tel: (215) 265-7000
TWX: 510-660-2670

**RHODE ISLAND**
873 Waterman Ave.
**East Providence** 02914
Tel: (401) 434-5535
TWX: 710-381-7573

**TEXAS**
P.O. Box 1270
201 E. Arapaho Rd.
**Richardson** 75080
Tel: (214) 231-6101
TWX: 910-867-4723

P.O. Box 22813
6300 Westpark Drive
Suite 100
**Houston** 77027
**Tel:** (713) 781-6000
TWX: 910-881-2645

231 Billy Mitchell Road
**San Antonio** 78226
Tel: (512) 434-4171
TWX: 910-871-1170

**UTAH**
2890 South Main Street
**Salt Lake City** 84115
Tel: (801) 487-0715
TWX: 910-925-5681

**VERMONT**
P.O. Box 2287
Kennedy Drive
**South Burlington** 05401
Tel: (802) 658-4455
TWX: 710-224-1841

**VIRGINIA**
P.O. Box 6514
2111 Spencer Road
**Richmond** 23230
Tel: (703) 285-3431
TWX: 710-956-0157

**WASHINGTON**
433-108th N.E.
**Bellevue** 98004
Tel: (206) 454-3971
TWX: 910-443-2303

***WEST VIRGINIA**
**Charleston**
Tel: (304) 768-1232

**FOR U.S. AREAS NOT LISTED:**
Contact the regional office near est you: Atlanta, Georgia . . North Hollywood, California . . Paramus, New Jersey . . . Skokie Illinois. Their complete addresses are listed above.

*Service Only

## CANADA

**ALBERTA**
Hewlett-Packard (Canada) Ltd.
11745 Jasper Ave.
**Edmonton**
Tel: (403) 482-5561
TWX: 610-831-2431

**BRITISH COLUMBIA**
Hewlett-Packard (Canada) Ltd.
4519 Canada Way
**North Burnaby** 2
Tel: (604) 433-8213
TWX: 610-922-5059

**MANITOBA**
Hewlett-Packard (Canada) Ltd.
511 Bradford Ct.
**St. James**
Tel: (204) 786-7581
TWX: 610-671-3531

**NOVA SCOTIA**
Hewlett-Packard (Canada) Ltd.
2745 Dutch Village Rd.
Suite 203
**Halifax**
Tel: (902) 455-0511
TWX: 610-271-4482

**ONTARIO**
Hewlett-Packard (Canada) Ltd.
880 Lady Ellen Place
**Ottawa** 3
Tel: (613) 722-4223
TWX: 610-562-1952

Hewlett-Packard (Canada) Ltd.
50 Galaxy Blvd.
**Rexdale**
Tel: (416) 677-9611
TWX: 610-492-4246

**QUEBEC**
Hewlett-Packard (Canada) Ltd.
275 Hymus Boulevard
**Pointe Claire**
Tel: (514) 697-4232
TWX: 610-422-3022
Telex: 01-20607

**FOR CANADIAN AREAS NOT LISTED:**
Contact Hewlett-Packard (Canada) Ltd. in Pointe Claire, at the complete address listed above.

## CENTRAL AND SOUTH AMERICA

**ARGENTINA**
Hewlett-Packard Argentina S.A.C.e.I
Lavalle 1171 - 3°
**Buenos Aires**
Tel: 35-0436, 35-0627, 35-0431
Telex: 012-1009
Cable: HEWPACKARG

**BRAZIL**
Hewlett-Packard Do Brasil I.e.C. Ltda.
Rua Frei Caneca 1119
**Sao Paulo** - 3, SP
Tel: 288-7111, 287-5858
Cable: HEWPACK Sao Paulo

Hewlett-Packard Do Brasil I.e.C. Ltda.
Rua da Matriz 29
Botafogo ZC-02
**Rio de Janeiro**, GB
Tel: 246-4417
Cable: HEWPACK Rio de Janeiro

Hewlett-Packard Do Brasil Indústria e Comercia Ltda.
Praca Dom Feliciano 78

**CHILE**
Héctor Calcagni y Cia, Ltda.
Bustos, 1932-3er Piso
Casilla 13942
**Santiago**
Tel: 4-2396
Cable: Calcagni Santiago

**COLOMBIA**
Instrumentacion
Henrik A. Langebaek & Kier Ltda.
Carrera 7 No. 48-59
Apartado Aereo 6287
**Bogota**, 1 D.E.
Tel: 45-78-06, 45-55-46
Cable: AARIS Bogota
Telex: 044-400

**COSTA RICA**
Lic. Alfredo Gallegos Gurdián
Apartado 3243
**San José**
Tel: 21-86-13
Cable: GALGUR San José

**ECUADOR**
Laboratorios de Radio-Ingenieria
Calle Guayaquil 1246
Post Office Box 3199
**Quito**
Tel: 12496
Cable: HORVATH Quito

**EL SALVADOR**
Electrónica
Apartado Postal 1589
27 Avenida Norte 1133
**San Salvador**
Tel: 25-74-50
Cable: ELECTRONICA
San Salvador

**GUATEMALA**
Olander Associates Latin America
Apartado Postal 1226
Ruta 4, 6-53, Zona 4
**Guatemala City**
Tel: 63958
Cable: OLALA Guatemala City

**MEXICO**
Hewlett-Packard Mexicana, S.A. de C.V.
**Moras** 439
Col. del Valle
Mexico 12, D.F.
Tel: 575-46-49, 575-80-20, 575-80-30

**NICARAGUA**
Roberto Terán G.
Apartado Postal 689
Edificio Terán
**Managua**
Tel: 3451, 3452
Cable: ROTERAN Managua

**PANAMA**
Electrónico Balboa, S.A.
P.O. Box 4929
Ave. Manuel Espinosa No. 13-50
Bldg. Alina
**Panama City**
Tel: 30833
Cable: ELECTRON Panama City

**PERU**
Fernando Ezeta B.
Avenida Petit Thouars 4719
Miraflores
Casilla 3061
**Lima**
Tel: 45-2335
Cable: FEPERU Lima

**PUERTO RICO**
San Juan Electronics, Inc.
P.O. Box 5167
Ponce de Leon 154
Pda. 3-Pta. de Tierra
**San Juan** 00906
Tel: (809) 725-3342
Cable: SATRONICS San Juan
Telex: SATRON 3450 332

**SURINAME**
Surtel-Radio Holland N.V.
P.O. Box 155
**Paramaribo**

**URUGUAY**
Pablo Ferrando S.A.
Comercial e Industrial
Avenida Italia 2877
Casilla de Correo 370
**Montevideo**
Tel: 40-3102
Cable: RADIUM Montevideo

**VENEZUELA**
Hewlett-Packard De Venezuela C.A.
Apartado 50933
**Caracas**
Tel: 71.88.05, 71.88.69, 71.99.3
Cable: HEWPACK Caracas

**FOR AREAS NOT LISTED, CONTACT:**
Hewlett-Packard
INTERCONTINENTAL
3200 Hillview Ave.
**Palo Alto**, California 94304
Tel: (415) 326-7000
(Feb. 71 493-1501)
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8461